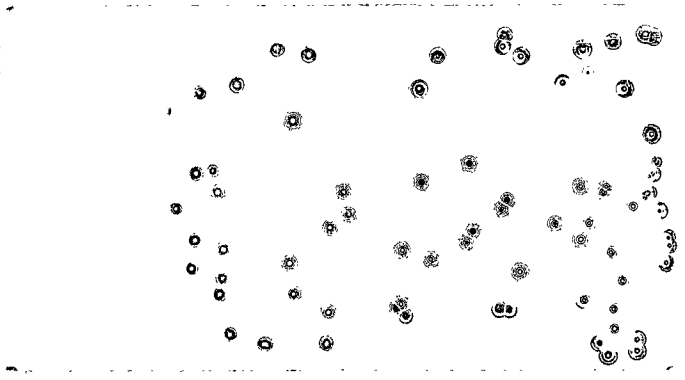
63-4-2



DUNLAP AND ASSOCIATES, INC.

STAMFORD, CONNECTICUT
SANTA MONICA, CALIFORNIA
SUNNYVALE, CALIFORNIA
WASHINGTON, D.C.

A STUDY OF PROCUREMENT COSTS AT THE SHIPS PARTS CONTROL CENTER

Volume II

Determination of Cost Functions

Prepared for:

Advanced Logistics Research Division
Bureau of Supplies and Accounts
Department of the Navy

31 July 1961

Contract No. Nonr-2860(00)

Dunlap and Associates, Inc.
429 Atlantic Street
Stamford, Connecticut

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SYMBOLS USED IN DOLLAR COST MODELS

A. Symbols Denoting Variables

Symbol	Variable	Units of Measure
A_h	Field transaction reports, H-cog	Line items per year
A_p	Field transaction reports, P-cog	Line items per year
B_h	Action forms, H-cog	Line items per year
C_h	Replenishment recommendations, H-cog	Line items per year
C_p	Replenishment recommendations, P-cog	Line items per year
D_h	Passed requisitions, H-cog	Line items per year
E_h	NIS purchase requisitions, H-cog	Line items per year
E_p	NIS purchase requisitions, P-cog	Line items per year
F_h	NSI purchase requisitions, H-cog	Line items per year
F_p	NSI purchase requisitions, P-cog	Line items per year
G_h	Provisioning items, H-cog	Line items per year
G_p	Provisioning items, P-cog	Line items per year
H_h	Purchase orders, not processed by Buying, H-cog	Documents per year
H_p	Purchase orders, not processed by Buying, P-cog	Documents per year
J_h	Other purchase orders, H-cog	Documents per year
J_p	Other purchase orders, P-cog	Documents per year

Symbol	Variable	Units of Measure
K_h	Negotiated contracts, H-cog	Documents per year
Kp	Negotiated contracts, P-cog	Documents per year
L_h	Advertised contracts, H-cog	Documents per year
L_p	Advertised contracts, P-cog	Documents per year
M_h	Stock list, H-cog	Line items on stock list
M_p	Stock list, P-cog	Line items on stock list

B. Symbols Denoting Constants

Symbol	Constant	Units of Measure
Subscript ah	Expenditures on allowance and load lists, H-cog	Dollars per year
Subscript ap	Expenditures on allowance and load lists, P-cog	Dollars per year
Subscript nh	Expenditures on nonpertinent workloads, H-cog	Dollars per year
Subscript np	Expenditures on nonpertinent workloads, P-cog	Dollars per year
Subscript nm	Expenditures on nonpertinent workloads, NSD Mechanicsburg	Dollars per year
Subscript f	Fixed expenditures	Dollars per year

SYMBOLS USED IN ELAPSED TIME MODELS

Symbols	Definitions
U_1	Ratio of passed requisitions routed to the Technical Division to total passed requisitions received at SPCC.
U_2	Ratio of replenishment recommendations routed to equipment specialists to total replenishment recommendations produced.
U_3	Ratio of procurements for stock which are not processed by personnel in the Buying Branch of the Purchase Division to total procurements for stock.
U_4	Ratio of procurements for stock which are purchase orders and have requests for quotes to total procurements for stock.
U_5	Ratio of procurements for stock which are negotiated contracts and have requests for quotes to total procurements for stock.
U_6	Ratio of procurements for stock which are advertised contracts to total procurements for stock.
U_7	Ratio of procurements for end users which are not processed by personnel in the Buying Branch of the Purchase Division to total procurements for end users.
U_8	Ratio of procurements for end users which are purchase orders and have requests for quotes to total procurements for end users.
U_9	Ratio of procurements for end users which are negotiated contracts and have requests for quotes to total procurements for end users.
U_{10}	Ratio of procurements for end users which are advertised contracts to total procurements for end users.
V_1	Number of days between the beginning of two consecutive supply-demand reviews for the same fraction of items.
V_2	Number of days between the cut-off date for the receipt of transaction reports for a supply-demand review and date the verified R.R.'s are released to the Technical Division.

Symbols	Definitions
W_1	Ratio of number of buying actions received in Buying Branch of Purchase Division to nonadministrative "productive" man-hours in Buying Branch, per month.
W_2	Ratio of number of documents received in Document Production Section of Purchase Division to nonadministrative "productive" man-hours in Document Production Section, per month.

VIII. INTRODUCTION TO VOLUME II

A. General

The detailed analyses of SPCC operations that were made in order to develop short- and long-run dollar cost and elapsed time functions (models) for SPCC are described in this volume of the report. Volume I presented the more general aspects of the research, including the conceptual formulation of the research problem, the general methodology employed, a summary of the numerical results, and the utilization of the results. In contrast, this volume describes the characteristics of the operations studied and presents details of the data used and the methodology employed. Thus, whereas Volume I is of interest to all users of this research, this volume will be of interest primarily to those concerned with working with the detailed data for such purposes as evaluating certain special kinds of decisions, updating the numerical results, estimating the effects of unforeseen system changes such as the introduction of new equipment, and extension of the results to other supply activities. Of course, this volume will also be of interest to those wishing to learn how SPCC operates or to those wishing to assess the quality, thoroughness, and reliability of the results presented in Volume I.

Chapters IX through XVI of this volume contain detailed analyses of SPCC on a division-by-division basis. There is one chapter for each division, except that the Office of the Commanding Officer is included in the chapter dealing with the Administrative and Management Planning Division. Each chapter contains a description of the division and a detailed analysis of the costs of labor, machine rentals, and paper consumed in the division. Such costs comprise about 96.5% of total SPCC expenditures.[1] Predictive models covering these costs are developed for each division. Finally, these chapters contain analyses of the elapsed times incurred in the divisions.

All dollar costs incurred at SPCC which are not treated in Chapters IX through XVI are analyzed in Chapter XVII. Chapter XVIII shows the synthesis

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1 The term "total SPCC expenditures," as used in this report, refers to total financial obligations incurred by SPCC. It includes the cost of services supplied by SPCC to Subarpso and NSD Mechanicsburg but does not include the cost of services provided by NSD Mechanicsburg to SPCC. These are treated in Chapter XVII.

of all of the dollar costs into over-all short-run and long-run predictive cost models for SPCC. In addition, Chapter XVIII shows the synthesis of the elapsed time functions for each division into over-all elapsed time models for SPCC. Flow diagrams prepared to show the principal work flows pertaining to procurement at SPCC are given in Appendix I.

There are many elements which are common to each of the divisional analyses which follow. These common elements are presented in this chapter and are not explicitly stated in the subsequent chapters. Sections B, C, and D of this chapter describe how the principal components of dollar costs incurred at SPCC (labor costs, machine rental costs, and paper costs, respectively) are treated in the separate analyses of each division. Section E discusses the treatment of other dollar costs. The treatment of elapsed times is described in Section F.

B. Labor Costs

Labor costs comprise the largest category of dollar costs. They account for over 85% of the total SPCC expenditures. Labor costs are significant in each of the divisions of SPCC and, therefore, are included in each of the separate analyses for each division.

The term "labor cost," as it is used in this report, includes the cost of:

1. "Productive" labor (i.e., actual time spent on-the-job and directly chargeable as such).
2. "Nonproductive" labor (i.e., regular paid leave, holiday leave, and terminal leave).
3. Fringe benefits (i.e., retirement pay, life insurance, social security, medical care, etc.).

Military labor as well as civilian labor is included. There are approximately 1400 employees at SPCC of whom 35 are military personnel. Table VIII-A shows the estimates of current labor costs at SPCC which are used throughout this study. The costs are broken down according to rank (for Naval personnel) and grade (for civilian personnel).

Column (2) shows the estimated annual compensation of personnel at each rank or grade. These figures include compensation for "nonproductive" labor, but do not include fringe benefits. The estimates for civilian personnel

are the salaries effective 10 July 1960 for employees having a rate of "e" in the U.S. Civil Service classification scheme. (A rate of "e" was selected as being close to the average rate for employees at SPCC.) The estimates for Naval personnel are the sum of (1) regular pay, (3) basic allowance for quarters for personnel with dependents, and (3) basic allowance for subsistence.[1]

Column (3) of Table VIII-A shows the estimated labor cost per "productive" man-hour for personnel at each rank or grade.[2] It includes the costs of "nonproductive" labor and fringe benefits. These estimates were calculated by a two-step procedure. First the annual compensations shown in column (2) were multiplied by a factor to include the cost of fringe benefits. The factor used for military employees was 1.15631.[3] The factor used for civilian employees was 1.07117.[4] Second, the resulting figures were divided by 1759, which is the estimated number of "productive" hours per employee per year.

The estimated number of "productive" hours per employee per year was calculated as follows: It was assumed that there are 365-1/4 days, or 52.18 weeks per year. Employees are compensated for 40 hours per week, or for 52.18 x 40 = 2087 hours per year. However, 15.73% of the paid hours are "nonproductive."[5] Thus, there are (1.0000 - 0.1573)x2087, or 1759 "productive" hours per employee per year.

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1 Register of Commissioned and Warrant Officers of the United States Navy & Marine Corps, and Reserve Officers on Active Duty, NAVPERS 15,018, 1 Jan. 1960, United States Government Printing Office, Washington, D.C.

2 Military compensation is based on the following assumptions as to years of service: Captain, 26-30; Commander, 20-22; Lieutenant Commander, 14-16; Lieutenant, 6-8; Lieutenant Junior Grade, 2-3; Ensign, 0-2; Chief Petty Officer, 16-18; Petty Officer, 1st Class, 10-12.

3 This factor was derived from figures given in The Budget of the United States Government for the Fiscal Year Ending June 30, 1961, United States Government Printing Office, Washington, D.C. It includes allowances for the following costs, expressed as a percentage of annual compensation:

Medical care	3.163
Retirement	7.125
Other (moving expenses, etc.)	5.343
	15.631

4 This is the ratio of total civilian labor costs to total civilian "productive" and "nonproductive" labor costs for fiscal year 1960, as reported in the SPCC Supply Management Reports, Part II, Fiscal Year 1960.

5 See SPCC Supply Management Reports, Part II, Fiscal Year 1960.

Table VIII-A

Estimated labor costs per employee by rank or grade

Rank or grade	Annual compensation	Total labor cost per "productive" man-hour
(1)	(2)	(3)
Captain	$ 14,036	$ 9.23
Commander	11,156	7.33
Lieutenant Commander	8,851	5.82
Lieutenant	7,086	4.66
Lieutenant Junior Grade	5,197	3.42
Ensign	4,268	2.81
Chief Petty Officer	5,400	3.55
Petty Officer, 1st. Class	4,560	3.00
GS-14	13,250	8.07
GS-13	11,675	7.11
GS-12	9,995	6.09
GS-11	8,600	5.24
GS-10	7,655	4.66
GS- 9	7,095	4.32
GS- 8	6,545	3.99
GS- 7	6,015	3.66
GS- 6	5,490	3.34
GS- 5	5,005	3.05
GS- 4	4,460	2.72
GS- 3	4,180	2.55
GS- 2	3,920	2.39
GS- 1	3,605	2.20

C. Machine Rental Costs

Machine rental costs comprise the second largest category of dollar costs, accounting for a little less than 10% of total SPCC expenditures. The only machine rental costs incurred at SPCC are the electric accounting machine (EAM) and electronic data processing machine (EDPM) rental costs. These machines are used only by the Data Processing Division. Therefore, their costs are discussed only in the analysis of that division.

D. Paper Costs

The term, "paper cost," as it is used in this report, includes the cost of:

1. Printed forms which are purchased by SPCC.
2. Special purpose supplies, such as EAM and EDPM supplies, which are purchased by SPCC.
3. Government forms which are supplied to SPCC without charge.
4. Printing and reproduction services which are supplied to SPCC by NSD Mechanicsburg.

Item 4 (above) is the largest of these costs. Item 3 is very small. Items 1 and 2 are the only ones included in SPCC expenditures and account for a little less than 3% of total expenditures.

Paper costs are significant in some divisions and are included in the separate analyses of the Data Processing Division, the Purchase Division, and the Allowance and Publications Division. Paper costs that are not directly associated with the workloads in one of these divisions are included in the analysis of the Administrative and Management Planning Division. Paper costs are not treated in the analyses of other divisions.

E. Other Dollar Costs

Other dollar costs incurred at SPCC include:

1. Other SPCC expenditures, such as expenditures for office supplies, for travel and per diem, for communication facilities, for repair of office equipment, and for minor property.

2. The cost of services (except printing and reproduction services) supplied to SPCC by NSD Mechanicsburg.

3. The cost of capital invested in the land, buildings, and equipment used by SPCC.

These costs are analyzed in Chapter XVII.

F. Elapsed Times

The term, "elapsed time," as it is used in this report, is, in general, the difference between the time that units of work are received and the time that these units are completed. There are elapsed times associated with each kind of work in each division at SPCC, but not all elapsed times are analyzed in this report. Rather, the elapsed times associated with two general classes of workloads that result in almost all of the H-cog procurement actions at SPCC are analyzed.

First, the elapsed times associated with the replenishment of systems stocks are analyzed. This time begins when transaction reports from field activities are received at SPCC. The elapsed time ends when purchase orders or contracts are let.

Second, the elapsed times associated with the processing of passed requisitions are analyzed. This time begins when passed requisitions are received at SPCC. The elapsed time ends when redistribution action is taken or (if procurement action is taken) when purchase orders or contracts are let.

The above classes of workload involve only the Stock Control Division, the Data Processing Division, the Technical Division, the Financial Control Division, and the Purchase Division so that elapsed times are not treated in the analyses of the other divisions.

IX. STOCK CONTROL DIVISION

A. Description

1. General

The Stock Control Division performs the inventory control function for H-cog material. The division employs about 178 people, including five officers, and has six branches. The branches include the Programs Branch, the Progress Branch and four Commodity Branches.

In general, the major functions of the division include establishing and maintaining levels of supply at reporting field activities, processing passed requisitions, and accomplishing the above by redistribution, procurement, or disposal. In addition, the division submits estimates of financial requirements for the ships parts inventory and carries out special programs involved with the control of inventory. The division does not handle any P-cog items.

Besides the six branches mentioned above and described in detail below, the division director has an administrative staff of six civilians.

2. Programs Branch

The Programs Branch, with a staff of 20 civilians and one officer, is responsible for the development and coordination of planning for various stock control programs, including base load lists, mobilization requirements, provisioning, internal procedures, and special projects. The workload of this branch is, for the most part, independent of the variable workloads considered in this report, except for three people involved in routine provisioning coordination.

3. Progress Branch

The Progress Branch, which has a staff of 42 civilians and one officer, receives and processes all incoming requisitions. It maintains progress control and follow-up files and a file of completed requisitions. It is also responsible for preparing outgoing shipment orders.

The branch is composed of three sections: Expediting and Status, Processing Control, and Receipt and File. The sections are further broken down into units along functional lines. For reasons which will become apparent

later, the Shipment Order Unit of the Processing Control Section, which has five employees, will be treated separately from the rest of the branch.

4. Commodity Branches

The four Commodity Branches are responsible for making periodic supply-demand reviews, for determining material requirements, for processing stock status reports, for meeting system and activity requirements by initiating procurement or redistribution action, for processing passed requisitions, for controlling allocation and reallocation of contracted material, and for miscellaneous other duties associated with inventory control.

The branches are organized along commodity lines. The four branches and their approximate current staffings are:

Electrical Branch	30
Machinery Branch	29
Engines Branch	20
Mechanical Branch	26

In addition, two officers supervise the four branches.

5. Work Flows

There are three major work flows treated in this report (stock replenishments, requisitions, and provisioning items) and all are handled by the Stock Control Division.

Machine recommendations on stock replenishments and redistributions, in the form of action forms, arrive in Stock Control along with stock status reports on each item requiring action. They are routed to the Commodity Branches where review of the machine recommendations is made. The amended action forms are returned to Data Processing where replenishment recommendations (R.R.'s) and shipment orders are prepared from the action forms. R.R.'s are then sent to the Commodity Branches for final approval and then forwarded to the Purchase Division.

Requisitions from the field arrive in the Progress Branch which maintains control of the requisitions as long as they are in SPCC. From here they are forwarded to the appropriate Commodity Branch where the Supply Commodity Assistants determine whether they should be redistributed or purchased. Redistributions are forwarded to the Shipment Order Unit which prepares and

sends shipment orders for the redistributions to the appropriate field activity. If an item cannot be identified, or needs specifications for procurement or substitution, it is forwarded to the Technical Division, and then to the Purchase Division.

Provisioning items are processed first in the Programs Branch. Provisioning R. R.'s are forwarded to the Commodity Branches for review and then to the Purchase Division.

A detailed diagram of the work flows in the Stock Control Division is presented in Appendix I.

B. Labor Costs

1. Workloads

The following workload variables are pertinent for the Stock Control Division:

A_h - Field Transaction Reports, H-cog: Certain aspects of the workload generated by transaction reports, such as maintenance of the consolidated stock status reports, are handled by the Stock Control Division even though the actual transaction reports arrive in Data Processing. These transactions include all reports from the field on issues, receipts, obligations, and dues. During fiscal 1960, the total number of transaction reports for H-cog material amounted to 973,140.[1]

B_h - Action Forms, H-cog: A 6210 or action form is produced by Data Processing for every stock list item on which a system or activity requirement exists. In addition, action forms on all fast fraction items list recommendations (i.e., procure, redistribute, etc.; to where; and how much).

The supply-demand review made by each stock analyst consists of reviewing the action form and consolidated stock status report for each stock item under his jurisdiction. During fiscal year 1960, 231,432 action forms were processed.[2]

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1 This number is based on an eleven-month estimate prorated to the twelfth month. During February, transaction reports were not counted because of Data Processing involvement with other work.

2 This number is based on a three-week reviewing cycle. In the first quarter of 1960, SPCC began operating on a two-week reviewing cycle. An analysis of three months of data under the two-week reporting cycle leads to an estimate of 313,600 for fiscal 1961 and this estimate will be used in all further analysis. See Stock Control Work Measurement Reports, Fiscal Year 1960.

D_h - Passed Requisitions, H-cog: This variable includes all passed requisitions received by Stock Control. It does not include requisitions received by Stock Control which arise from special programs such as provisioning, allowance and load list preparation, ship alterations, the Military Assistance Program (MAP) or, the Reserve Fleet Deficiency in Allowance Requirements Program (DIA).

During fiscal year 1960, 121,142 line items on passed requisitions were processed by the Stock Control Division.[1] For the most part each requisition was only one line item.

G_h - Provisioning Items, H-cog: This variable measures all work that results from the receipt of provisioning documents at SPCC except any additional work that may be required if a decision to procure is made and a requisition is prepared. The measure used for the provisioning variable is a count of line items on provisioning forms which are reviewed by the Technical Division. During fiscal year 1960, 144,278 provisioning items were reviewed.[2]

M_h - Stock List, H-cog: A portion of the workload of the Stock Control Division is concerned with the maintenance of files and records, and the review of items on the stock list. Much of this Stock Control work apparently would vary with the number of items on the stock list. Since the size of the stock list can vary over time and could be affected by some decision alternatives of interest, it is included here as a relevant workload variable.

The size of the stock list for H-cog materials on 30 June 1960, as measured by standard stock numbers on the Navy Stock List, was 133,443 items.[3]

The following workload constants are applicable to the analysis of the Stock Control Division:

Subscript ahl - Allowance and Load List, H-cog: Some of the workloads in the Stock Control Division are independent of the decision alternatives of interest in this report. The costs resulting from these workloads are

1 Supply Management Reports, Part I, Page 1, Line A14A, Fiscal Year 1960.

2 Supply Management Reports, Part I, Page 2, Line A21A, Fiscal Year 1960.

3 Supply Management Report, Part III, Page 1, Line 16, June 1960.

included in this study but are treated as constant. In general, such costs are not segregated by type of workload. However, the costs which result from the Allowance and Load List Program are segregated into a special category since they comprise a substantial part of SPCC costs and, for certain special classes of decisions, might be pertinent. This category includes all of the costs in the Stock Control Division which are traceable to the Allowance and Load List Program.

Subscript mh -- Nonpertinent Workloads, H-cog: The costs included in this category consist of all H-cog workloads which are independent of the decision alternatives of interest in this study except the workloads associated with the Allowance and Load List Programs. It does not include those fixed workloads described below.

Subscript f - Fixed Costs: This category includes those costs which may be pertinent to the decisions being considered, but which do not vary over the range of workloads being considered. That is, they are costs which are expected to remain constant in the long run over a wide range of workloads, such as the cost of the division director's staff.

2. Man-Hours

The Stock Control Division performs work associated with each of the workloads listed above. Personnel in the division charge time to work measurement functions. The procedure for estimating man-hours associated with the relevant workload variables and constants, involved relating work measurement functions to the workloads. This is illustrated in Table IX-A. The first column gives the work measurement function numbers, the second column shows the functions briefly, and the third lists the corresponding workload symbols.

The table includes all of the functions to which time is currently being charged under the Stock Control work measurement reporting system. The work measurement reports do not break down the time charges of the Programs Branch.

The assignment of man-hours to workloads was based on interviews and on an analysis of operations and tasks on a detailed level. The results are shown in Table IX-B. The table also shows the time charged to each of the functions and the time allocated to division management and branch management, as well as a breakdown of the time by Commodity Branch. An allocation of time for the Programs Branch to work measurement functions, based on interview data, is also included.

Table IX-A

Correspondence between Stock Control Division functions and workloads

Function No.	Function[1]	Workload symbol[2]
611A	Recomputation of EDPM Requirements	B_h
611B	Computation of Requirements for New Items	G_h
611C	Adjusting and Maintaining CSSR	A_h
611D	Review of Excess Lists	M_h
612A	Assignment of Codes	M_h
612B	Review of Codes	M_h
612C	Review of Additions or Deletions to Stock List	G_h
612D	Prepare 6583[3] Form	G_h
612E	Supply Support of Other SDCP's	G_h
612F	Standardization and Coordination Studies	M_h
613A	Processing of Disposition Instructions	M_h
621	Requisition Control	D_h
622	Supply-Demand Review--Shipment Order Unit	$B_h + D_h$ [4]
622A	Passed Requisitions	D_h
622B	Interim Requisitions	D_h
622C	Stock Status Reports	B_h
622D	CSSR Shipment Order Cuts	A_h
624A	Provisioning for New Equipment	G_h
624B	Allowance and Load Lists	Subscript a_h
624C	Special Programs	Subscript n_h

(1) For a complete description of these functions see SPCC - SCINST 5202.2B, 18 February 1958.

(2) See Section B.1 of this chapter for meaning of symbols.

(3) This form is for additions or deletions to stock lists.

(4) Contrary to SPCC - SCINST 5202.2B, 18 February 1958, the Shipment Order Unit uses this function number and processes redistributions which arise from stock status reviews as well as requisitions.

Table IX-B

Estimated total "productive" man-hours by workload and branch
(fiscal year 1960)

(for footnotes see next page)

Branch	Division staff	Programs	Progress	Electrical[1]	Machines[1]	Engines[1]	Mechanical[1]	Total	Workload symbols: Variables	Constants
Function										
611A				2161	1784	1513	2246	7704	B_h	
611B				104	26	79	42	251	G_h	
611C				22633	10921	16697	17423	67674	A_h	
611D				1576	410	671	1194	3851	M_h	
612A				1187	1907	1505	1427	6026	M_h	
612B				35	26	19	6	86	M_h	
612C				98	509	366	325	1298	G_h	
612D				1462	1272	843	1984	5561	G_h	
612E				25	26	166	17	234	G_h	
612F				80	151	173	172	576	M_h	
613A				157	370	167	137	831	M_h	
621			63023					63023	D_h	
622			3689					3689	D_h[2]	
622			5466					5466	B_h	
622A				8627	7558	7560	8404	32149	D_h	
622B				146	184	151	29	510	D_h	
622C				10423	18766	4157	7209	40555[3]	B_h	
622D				134	116	157	133	540	A_h	
624A		7036[4]		1059	1018	394	1088	10595	G_h	
624B				340	137	124	315	916		Subscript ah
624C		21108[4]		270	461	37	127	22003		Subscript nh
Div. Mgt.	12313[5]							12313		Subscript f
Branch Mgt.		7036[4]	5277	4398	4398	4398	4398	29905		Subscript f
Total	12313	35180	77455	54915	50040	39177	46676	315756		

Table IX-B (Continued)

Footnotes:

(1) The breakdown between the four Commodity Branches is based on 11-month data plus a proration of the twelfth. (During the first month of fiscal 1960 there were five Commodity Branches.)

(2) Based on proration of time between requisitions and redistributions arising from stock status reviews.

(3) Supervisors charge time to function 622C. Appropriate deductions were made from the data for function 622C and added to "Branch Management." For the Progress Branch they were based on Military Supervisor, Branch Supervisor and Branch Clerk. In Commodity Branches, one officer supervises two branches, but in Programs Branch, there are two officers. Also, based on 1759 hours per "productive" man-year (see Chapter VIII, Section B, of this volume).

(4) No breakdown of data is available for the Programs Branch; four people are involved in provisioning and four in branch management. The remainder perform miscellaneous tasks.

(5) Based on a staff of seven with 1759 "productive" man-hours per employee per year (see Chapter VIII, Section B).

Consequently, average productivities during fiscal year 1960 were used as estimates of productivities underlying the long-run model for the Stock Control Division. Activity rates in this division (as well as in most of the other divisions at SPCC) appeared to be high, indicating that there is little excess capacity. That is, staffing levels could not be reduced appreciably either without in some way reducing the workload or without some reduction in the quality of performance. It was assumed that management would continue to act so as to maintain the existing average level of performance in the long run. In other words, management would adjust staffing, in the long run, so that average productivity would remain constant if the workload were to change.

Table IX-C is a summary of the man-hours by workloads and gives productivity estimates for each of these workloads, aggregated over all branches of the Stock Control Division. Productivity estimates were not made by branches because, although fairly reasonable man-hour data were available by branch, as is evidenced in Table IX-B, the measures of the significant workloads were not available on a branch basis.

3. Labor Costs per Man-Hour

Average labor costs per "productive" man-hour were estimated separately for each of the branches, excluding fixed personnel. Separate estimates were made of average labor costs per "productive" man-hour for all personnel on the division and branch staffs who were assumed to be fixed.

Table IX-D shows the estimated costs per "productive" man-hour. The first column shows the grades of the employees. The second column shows the estimated current average labor cost for each grade. The remaining columns show the assumed manning for each branch. They were used as weights to obtain the estimated average labor cost per "productive" man-hour for each branch. The estimated labor cost per "productive" man-hour for each branch is shown in the last row of the table.

4. Labor Costs Associated with Workloads

Table IX-E lists each workload, the average man-hours per unit of workload for each workload variable, the hourly cost applicable to the workload, and the unit costs. The data shown are derived from Table IX-B and Table IX-C. The hourly costs are based on the proportion of hours contributed to each workload by each branch. The last column is derived by multiplying column 2 by column 3. It shows the estimated unit variable labor costs associated with each of the workload variables.

Table IX-C

Man-hours and workloads
(fiscal 1960)

Workload symbol	Workload (line items)	Man-hours	Productivity (line items per man-hour)	Man-hours per line item
Variables				
A_h	973,140	68,214	14.27	.0701
B_h	313,600	53,725	5.84	.1712
D_h	121,142	98,371	1.23	.8120
G_h	144,278	17,939	8.04	.1244
M_h	133,443	11,370	11.74	.0851
Constants				
Subscript ah	--	916	--	--
Subscript nh	--	22,003	--	--
Subscript f(branch)	--	29,905	--	--
Subscript f(division)	--	12,313	--	--
Total		314,756		

Table IX-D

Labor cost per "productive" man-hour

Grade	Cost per man-hour[1]	Fixed personnel[2]		Variable personnel[2]		
		Division director's staff	Branch staff	Progress Branch	Programs Branch	Commidity Branches
Commander	$ 7.33	1	1			
Lieutenant	4.66		2			
Lt. j.g.	3.42		1			
GS-13	7.11	1				
GS-12	6.09		4			
GS-11	5.24	1	1		3	10
GS- 9	4.32	1			2	35
GS- 7	3.66		1		1	13
GS- 5	3.05	2		2	1	30
GS- 4	2.72			7	8	4
GS- 3	2.55	1	6	22	4	11
GS- 2	2.39			11		
Total Personnel		7	16	42	19	103
Average cost per "productive" man-hour		$ 4.66	$ 4.29	$ 2.56	$ 3.32	$ 3.70

(1) These include allowances for "nonproductive" labor and fringe benefits. See Chapter VIII, Section B of this report.

(2) Manning based on SPCC Manpower Listing, SECNAVINST 5320.4, 31 March 1960.

Table IX-E

Labor costs per unit of workload in Stock Control

Workload symbol	Man-hours per line item	Labor costs per man-hour	Labor costs per unit of workload
Variables			
A_h	.0701	$ 3.70(1)	$ .259
B_h	.1712	3.58(2)	.613
D_h	.8120	2.93(3)	2.379
G_h	.1244	3.55(4)	.441
M_h	.0851	3.70(1)	.315
Constants			
Subscript ah		$ 3.70(1)	
Subscript nh		3.32(4)	
Subscript f (branch)		4.29(5)	
Subscript f (division)		4.66(5)	

(1) The workloads corresponding to the A_h, the M_h, and the subscript ah symbols are processed in the Commodity Branches (see Table IX-B). $3.70 is the average labor cost per "productive" man-hour in the Commodity Branches.

(2) The workload corresponding to the B_h symbol is processed in the Commodity Branches and in the Progress Branch. The $3.58 is a weighted average of the average costs in the Commodity and Progress Branches, the weights being obtained from Table IX-B.

(3) The workload corresponding to the D_h symbol is processed in the Commodity Branches and in the Progress Branch. Here the weighted average is as shown.

(4) The workloads corresponding to the G_h and subscript nh symbols are processed in the Programs Branch and the Commodity Branches. The weighted averages are as shown and were obtained from Table IX-B.

(5) The hourly costs for branch and division fixed workloads are different and are treated separately.

Table IX-F shows the total annual labor costs associated with each of the workload variables and constants. These were developed by multiplying the unit cost by the value of the variable, or, in the case of constant workloads, the rate per "productive" man-hour by the number of man-hours.

C. Cost Models

1. General

The cost models given in this chapter include only labor costs. The costs of printed forms, paper, etc., consumed in the Stock Control Division are not significant. No machine rental costs are incurred in the Stock Control Division.

2. Short-Run Costs

All labor costs are treated as fixed in the short run (by definition). The estimated total labor costs in the Stock Control Division at current annual rates, as shown in Table IX-B, amount to $1,100,246. Thus, the short-run model is:

$$T_s = \$1,100,246_f$$

where T_s = total short-run annual dollar costs treated in this chapter.

3. Long-Run Costs

The estimated long-run labor costs for the Stock Control Division are given in the formula below, which is taken from Table IX-F:

$$T_l = 0.259\ A_h + 0.613\ B_h + 2.379\ D_h + 0.441\ G_h + 0.315\ M_h + 3,389_{ah} + 73,050_{nh} + 185,671_f$$

where T_l = total long-run annual dollar costs treated in this chapter, and where the other symbols are as defined in Section B.1 of this chapter.

D. Elapsed Times

1. General

In this section elapsed times in the Stock Control and Technical Divisions for H-cog requisitions are discussed. (Elapsed times for replenishment

Table IX-F

Labor costs in Stock Control Division

Workload symbol	Value of variable (line items)[1]	Man-hours[2]	Labor costs per unit of workload[3]	Labor costs per man-hour[4]	Estimated total annual labor costs
Variables					
A_h	973,140	--	$ .259	--	$ 252,043
B_h	313,600	--	.613	--	192,236
D_h	121,142	--	2.379	--	288,196
G_h	144,278	--	.441	--	63,627
M_h	133,443	--	.315	--	42,034
Constants					
Subscript ah	--	916	--	$ 3.70	3,389
Subscript nh	--	22,003	--	3.32	73,050
Subscript f (branches)	--	29,905		4.29	128,292
Subscript f (division)	--	12,313		4.66	57,379
Total annual labor cost in Stock Control Division					$ 1,100,246

(1) See Section B.1.

(2) From Table IX-C.

(3) From Table IX-E.

(4) Ibid.

recommendations are treated in conjunction with the discussion of elapsed times for the Data Processing Division.) The elapsed times considered in this section begin when passed requisitions are logged into Stock Control and end when they are released to the Purchase Division for procurement or after shipment orders are sent, whichever is the case. If a requisition requires processing by the Technical Division this time is included.

2. Data Utilized

Two sources of data were used to measure the elapsed times under consideration. The first source consisted of the sample data routinely collected by the Progress Branch of the Stock Control Division as a requirement set forth by Busanda. In collecting these data, three time categories are set up for each issue group.[1] The number of sampled requisitions falling into each category for each issue group and the total number in the sample are recorded. Each month a total of about 500 to 1,000 requisitions are sampled. The sample consists of requisitions processed on several selected days during the month. No attempt is made to guarantee that the sample is "representative" of all classes of requisitions (e.g., UNI, NIS or NSI; or redistributions or procurements), of all issue groups, or of all days during the month. The results of the sampling for calendar year 1960 are shown in Table IX-G.

The second source of elapsed time data consisted of a small sample of requisitions obtained from the Stock Control Division files. This sample was collected by the research team and classified according to whether or not the requisitions were sent to Technical and, if so, whether they were returned to Stock Control. The actual elapsed time, in days, in each division was recorded for each requisition. Also, the sample was stratified by priority, or issue group. The results of this sample are summarized in Table IX-H.

3. Analysis

The data collected by the Stock Control Division and summarized in Table IX-G were analyzed in several ways in order to determine the relationship

1 Issue groups correspond to priorities under the old Navy system. Priorities 1 through 10 are classified as issue group I and correspond to "emergencies." Priorities 11 through 20 are classified as issue group II and correspond to "schedules." Priorities 21 through 44 are classified as issue group III and correspond to "routines."

Table IX-G

Elapsed times in Stock Control and Technical Divisions for H-cog passed requisitions
(based on data collected by Stock Control Division for
calendar year 1960)

	Emergency requisitions			Scheduled requisitions			Routine requisitions		
	Less than 4 hours	4 hours to 2 days	More than 2 days	Less than 1 day	1 day to 5 days	More than 5 days	Less than 4 days	4 days to 10 days	More than 10 days
January	118	45	3	225	94	10	70	8	12
February	76	63	3	84	28	6	34	10	0
March	100	80	3	142	52	16	163	77	20
April	100	42	2	359	149	32	96	43	4
May	113	6	2	244	66	14	123	50	11
June	221	45	2	251	136	10	250	119	44
July	157	64	7	262	99	12	89	24	5
August	227	68	14	381	175	22	129	81	6
September	160	31	13	114	87	21	70	28	4
October	159	56	16	283	58	73	66	26	6
November	127	56	10	277	86	56	72	32	12
December	187	72	16	148	64	27	63	21	15
Total	1745	628	91	2770	1094	299	1225	519	139
Percentage	70.8	25.5	3.7	66.5	26.3	7.2	65.0	27.6	7.4

Table IX-H

Elapsed times in Stock Control and Technical Divisions for H-cog passed requisitions
(based on samples taken by research team)

Type of requisition		Size of sample	Average elapsed time in days		
Issue group	Sent to Technical?		Stock Control	Technical	Total
I Emergency	No	5	1.2	-	1.2
I Emergency	Yes	3	0.7	1.6	2.3
I Emergency	Combined	8	1.0	0.6	1.6
II Scheduled	No	25	1.4	-	1.4
II Scheduled	Yes	30	1.2	2.6	3.8
II Scheduled	Combined	55	1.3	1.4	2.7
III Routine	No	11	2.8	-	2.8
III Routine	Yes	11	0.8	2.8	3.6
III Routine	Combined	22	1.8	1.4	3.2
All Priorities	No	41	1.8	-	1.8
All Priorities	Yes	44	1.1	2.6	3.7
All Priorities	Combined	85	1.4	1.4	2.8

between elapsed times and workload volumes for requisitions. Many plots of the data using several different measures of elapsed time and workload input by months were made. However, there was little indication that elapsed times are affected by workload volumes over the range of workload levels for which data are available. The lack of significant correlations is not surprising for two reasons. First, the processing of requisitions is only a small part of the total workload for many of the people who process them and it takes priority over other work, so elapsed times would not be expected to be sensitive to the measure of workload input. Second, although the samples were fairly large, details of the sampling procedure are not entirely clear and the samples for a month may not be representative of all periods during the month.

The sample collected by the research team and summarized in Table IX-H was analyzed in detail. Four important facts emerged. First, whether the requisitions are sent to Technical and, if so, whether they are returned to Stock Control is important. The elapsed time in each division, as well as the total elapsed time, is affected. Second, the priorities of the requisitions are of lesser importance, particularly if the effect of sending the requisitions to the Technical Division is removed. Third, in any case, elapsed times in Stock Control and Technical are smaller (averaging less than 3 days) than the elapsed times in the Purchase Division (which average 1 to 2 weeks). Fourth, the total variation in elapsed times for requisitions is small. The standard deviation was estimated to be 2.3 days.

4. Model

A model to predict average elapsed time for requisitions through the Stock Control and Technical Division was developed on the basis of the foregoing analysis. This model takes into account the most important single cause of variation; that is, whether or not the requisitions are sent to the Technical Division. It was decided that the effect of workload volume is small enough to be neglected, at least over the range of workload volumes for which data are available. Also, the effect of priorities was neglected since it is small, especially when the effect of sending the requisitions to the Technical Division is removed, and since it is not an important determinant of elapsed times in the other divisions of SPCC.

The elapsed time model was determined from the data in Table IX-H. It is:

$$t_2 = 1.8 + 1.9U_1$$

where t_2 = average elapsed time for requisitions in the Stock Control and Technical Divisions in calendar days

U_1 = ratio of passed requisitions routed to the Technical Division to total passed requisitions received at SPCC.

The observed value of U_1 during the study was 0.52; that is, 52 per cent of all requisitions were routed to the Technical Division. The average elapsed times for requisitions through Stock Control and Technical is then 2.8 days.

Several other important facts are of note. All requisitions which become procurements must go to the Technical Division. Therefore, for this subclass of requisitions the elapsed time through Stock Control and Technical is 3.7 days. Some requisitions do not become procurements (i.e., they are redistributed). The fraction of redistributed requisitions which go to the Technical Division is .32 and therefore the average elapsed time for redistributions through Stock Control and Technical is 2.4 days.

X. DATA PROCESSING DIVISION

A. Description

1. General

The Data Processing Division employs a staff of about 210 people, an IBM 705 Mod 3 computer, and considerable other electronic data processing and electric accounting machine equipment. The division provides electronic data processing and electric accounting machine services to SPCC, Subarpso and NSD Mechanicsburg. It maintains, prepares and analyzes inventory control, fiscal accounting, and technical records.

The Data Processing Division has five branches, whose activities are described below. These are the Electric Accounting Machine Branch, the Records Control Branch, the Analysis Branch, the Program Branch, and the Electronic Data Processing Machine Branch.

2. Electric Accounting Machine Branch

This is the largest of the five branches with about 117 people. It is divided into four sections, one handling SPCC functions, one Subarpso functions, one NSD functions, and one for all keypunch operations. In turn the SPCC Functions Section is divided into two units, one for inventory control and one for technical. The NSD Functions Section is divided into two units. One performs stock accounting and one performs fiscal accounting. The Keypunch Section is divided, nominally at least,[1] into three units, one for Subarpso, one for SPCC, and one for NSD.

In general, the branch performs the tabulating, reproducing, collating, sorting, calculating, key punching, verifying, interpreting and summarizing functions required in the mechanized data processing operation for SPCC, Subarpso, and NSD, utilizing EAM equipment.

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1 Actually the keypunch operation has 43 people in the section plus three planner-schedulers, one in each of the units.

3. Records Control Branch

This branch is composed of three sections, Inventory Control, Technical Records, and Financial Inventory Control, and includes some 24 people. In general, this branch performs all clerical functions relating to the EDPM system and to EAM operations for SPCC, Subarpso, and NSD. This includes editing and reviewing the output of the EAM and the EDPM systems before submission to requestors, maintaining financial and work measurement statistics for the division, and preparing special reports on the operation of the EDPM and EAM equipment.

4. Analysis Branch

The Analysis Branch includes 12 people. The people in this branch are system analysts who assist in the determination of procedures for processing by EDPM and help to interpret the implications of EDPM results for users of EDPM services. The analysts act as coordinators between the programmers, the EDPM operators, and users of EDPM services.

5. Program Branch

This branch, with 27 people, is responsible for preparing machine programs for the Electronic Data Processing System. They specify all equipment setups and estimate operating times.

6. EDPM Branch

This branch includes 17 people who are directly responsible for the operating of the EDPM equipment. They process machine programs in accordance with procedures which have been prepared by the EDPM analysts and programmers.

7. Work Flows

The Data Processing Division handles two of the major work flows discussed in this report, namely stock replenishments, and provisioning items. Requisitions do not get processed by this division.

The stock replenishment work flow begins with the arrival of transaction reports from the field into the Records Control Branch, where they are assembled, edited and forwarded to the EAM Branch for sorting. The sorted transaction cards are then sent (weekly) to EDPM where the Perpetual Inventory

Record and Contract Status Records are updated to show the field transactions. Every two weeks a supply-demand review is conducted. A Cumulative Stock Status Report (CSSR) and an Action Form is produced for every item which has had a transaction during the previous review period. Recommendations (e.g., procure, redistribute, etc.) are made by the machine on all "fast" fraction items. The Action Forms and CSSR's are forwarded to Stock Control for review. When they are returned, changes are incorporated by EDPM and the R.R.'s, redistribution shipment orders, and reallocations are prepared by the EAM Branch. The R.R.'s go to Technical for specification and to Stock Control for final review. Shipment orders go to field activities and reallocations go to the Purchase Division.

With respect to Provisioning, the provisioning decisions are made in Technical and reviewed in Stock Control. EDPM only serves as a record keeping function. Provisioning documents are used to prepare Provisioning R.R.'s and to update the Planned Program Record.

A detailed diagram of the work flows in the Data Processing Division is presented in Appendix I.

B. Machine Rental Costs

1. General

Two classes of machines are employed in the data processing operations. The electric accounting machines (EAM), which include key punches, verifiers, tabulators, sorters, accounting machines, etc., comprise one group, and the electronic computer (IBM 705, Mod 3) with all its related equipment, including 19 tape drives, referred to as EDPM, comprise the second group.

It can be proposed that, once a machine is contracted for, its rental costs are fixed and, therefore, all machine rental costs are fixed and independent of changes in workload. Machine rental costs will not be treated as such in this study. They will be treated as partly fixed and partly variable, both in the short run and the long run. In support of this, consider the contracts under which the equipment is rented.

The contracts call for fixed fees for first-shift operation plus variable fees directly proportional to utilization for additional operations. These fees are usually considerably less per additional time period of operating than the basic fees. The equipment at SPCC is given considerable extra-shift

utilization. In fact, the 705 works almost three complete shifts, as might be expected under the rate structure. For this reason, a good part of the costs vary directly with workload, at least over a considerable range of operations.

Second, even over a significantly different range of operations, costs would vary pretty much with volume, it it is assumed that significant changes in volume would result in the rental of different equipment, or modification of the present, which would change the rental fee. This could take the form of either additions or subtractions of parallel units, or the selection of a complete alternative data processing system. So, in fact, a considerable range of costs can be experienced concomitant with changes in volume, in the long run, if management acts to alter the equipment.

2. EDPM Costs

The total annual rental cost for EDPM equipment in fiscal year 1960 was $832,854. Table X-A shows the quarterly rental fees and the associated "machine hours paid for."[1] These are also plotted in Figure X-A. The basic shift rental fee is $602,520. The difference between the total annual rental fee and this basic cost divided by the extra-shift machine hours is the average variable cost per extra-shift machine hour.[2]

The total cost associated with the rental of the EDPM system can be represented by a functional equation which takes the form of a constant term (for the basic-shift rental fee) plus a variable term (for the extra-shift machine hour costs).[3] Such an equation is shown at the bottom of Table X-A. The next task is to relate the variable term to the pertinent workloads.

---

1 "Machine hours paid for" are the number of hours for which SPCC is billed for utilization of the equipment by IBM. This measure of utilization is used extensively in this chapter because it is felt to be the most accurate.

2 It was assumed that the range of operations of interest in this study is in the extra-shift area, that is approximately 500 to 2000 hours per quarter.

3 Although the unit extra-shift rental fees are known, the combinations of machine utilizations may change slighly from month to month (resulting in the small scatter in Figure X-A), necessitating the development of the average extra-shift rental fee per hour from the aggregate data.

Table X-A

EDPM machine hours and rental fees -- fiscal year 1960

	Machine hours paid for	Rental fee
1st Quarter	996	$ 188,453
2nd Quarter	1221	210,047
3rd Quarter	1135	202,350
4th Quarter	1471	232,004
Annual Total	4823	$ 832,854
Basic Shift--Annual	2028[1]	$ 602,520
Extra Shift--Annual	2795	$ 230,334

Average variable cost per extra-shift machine hour =

$$\frac{\$\ 230,334}{2795} = \$\ 82.41$$

Total annual cost, 0 to 2028 machine hours = $ 602,520

Total annual rental cost, 2028 to 6084 machine hours =

$ 602,520 + 82.41 [machine hours - 2028]

(1) Basic shift based on 169 hours per month.

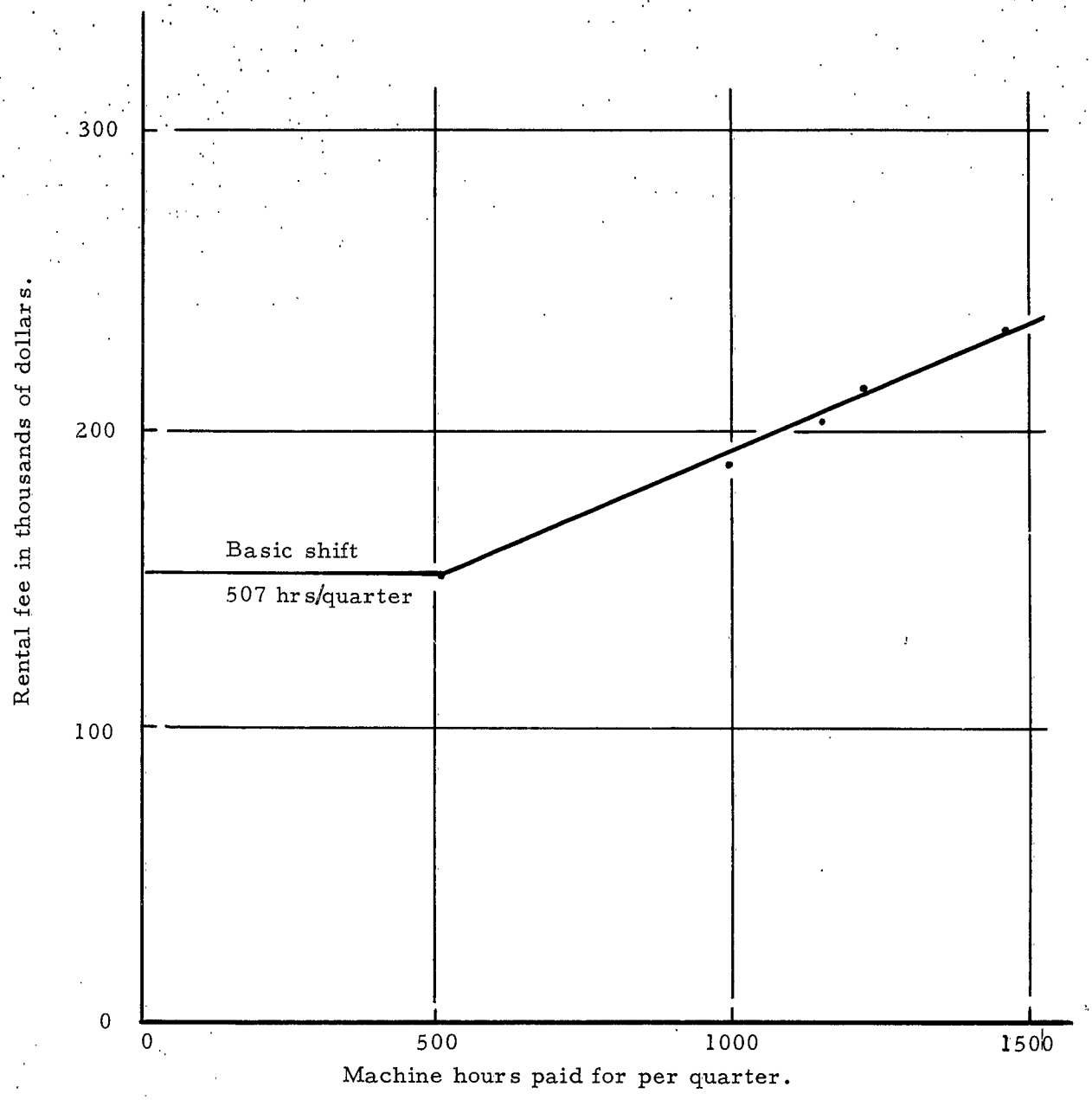

Figure X-A. EDPM rental fee vs. machine hours paid for, by quarters--fiscal year 1960.

A functional breakdown of EDPM time is kept as a matter of record for Busanda. The total time recorded in this breakdown is different than machine hours paid for, which is based on IBM billings. The percentage breakdowns of EDPM time by function, as recorded for Busanda, are shown in the first part of Table X-B. In the second half of Table X-B, these percentages are applied to "machine hours paid for." Using the variable cost per machine hour, the total cost applicable to each function is developed. Next, workloads corresponding to each function are shown and the unit cost of each variable workload and total cost of each constant workload are shown.[1] No attempt has been made to explain the rationale for assignment of functions to specific workloads. The assignments are based on interviews and analysis of subtasks, functions and schedules.

The final short-and long-run functional equation representing total EDPM rental costs developed from Table X-B is:

$$T_s = T_l = 0.312M_h + 0.312M_p + 0.0693A_h + 0.215A_p + 602,520_f$$

$$+ 57,534_{ah} + 12,630_{ap} + 14,691_{nh}$$

where T_s = total annual short-run EDPM rental costs, in dollars.

T_l = total annual long-run EDPM rental costs, in dollars.

and where the other symbols are shown in the list given in the front of this volume.

3. EAM Costs

EAM rental costs will be treated in a slightly different manner from EDPM costs. The electric accounting machines are characteristically smaller, moved easier, and essentially function independently of one another. The number of machines employed during fiscal 1960 has varied from 67 to 78; the number employed as of September of fiscal year 1961 was 83. The point is that the flexibility of the rental system provides management with the capability to make the acquisition or release of these machines almost directly variable with the volume of work to be done. For this reason all EAM rental fees will be considered variable costs, both in the short run and in the long run. Further, extra-shift operation is fairly small, averaging between 12% and 25% of total

1 See Chapter IV, Section B.2 of Volume I for complete definitions of the workload variables and constants.

Table X-B

EDPM functions, workloads, and rental costs--fiscal year 1960

(For footnotes see next page)

Functions	Technical	Allowance	Inventory Control	Budgets & Logistics	Management Aids	Subarpso	Total
1. Machine Hours Charged by Function							
1st Quarter	441	442	497	5	76	46	1507
2nd Quarter	350	484	463	12	29	163	1501
3rd Quarter	300	511	507	7	73	183	1581
4th Quarter	469	528	423	191	19	232	1862
Annual Sum	1560	1965	1890	215	197	624	6451
Percentage of Total	24.18	30.46	29.30	3.33	3.05	9.68	100.0
2. Unit Costs of Workloads							
Extra-shift hours paid for by function (1)	675.8	851.4	818.9	93.1	85.2	270.6	2795.0
Variable cost per hour = $82.41(2)							
Total variable cost for function(3)	$55,693	$57,534$_h$(4) 12,630$_p$ $70,164	$67,486	$7,672	$7,019	$22,300	$230,334
Workload variables corresponding to functions	$M_h + M_p$		A_h			A_p	
Constant workloads corresponding to functions		Subscripts ah + ap		Subscript nh	Subscript nh		
Annual workload(5)	178,700		973,140			103,620	
Unit cost of function	$0.312		$0.0693			$0.215	

Total variable cost = $145,469. Total cost of constant workloads = $687,377(6)

Table X-B (Continued)

Footnotes:

(1) Total extra-shift man-hours paid for, multiplied by per cent derived in upper half of table.

(2) From Table X-A.

(3) Variable cost per hour multiplied by number of machine hours paid for.

(4) This shows a total cost breakdown between H-and P-cog. It is based on the ratio of Subarpso, EDPM and EAM man-hours to SPCC, EDPM and EAM man-hours for work measurement functions 671, 672, and 673 (allowance lists and related functions) during fiscal year 1960.

(5) This is the present estimated annual workload count (in the appropriate units, depending on the specific workload) based on fiscal year 1960 data. [See Volume I, Chapter IV, Section B.2.]

(6) Includes the constant $602,520, developed in Table X-A, plus the nonpertinent and allowance workloads here.

utilization and contributing to less than 3% of total rental fees, so that no differentiation will be made between extra-shift and basic-shift costs.[1]

Table X-C lists EAM rentals and hours for fiscal 1960 and the first quarter of 1961. Figure X-B is a plot of the same data. The slope of the line represents the average hourly cost of $0.85 per hour. The plot also tends to support the assumption that machine utilization and, therefore, costs are flexible. To summarize, the total annual cost of EAM equipment for fiscal 1960 was $156,438 and the average hourly cost was $0.850.

No breakdown of the EAM operations by function was available on a historical basis. However, the EAM Branch is organized, pretty much, on a functional basis and the organizational staffing was used as a means of determining the percentage of effort spent on each workload. Table X-D shows the breakdown of the EAM staff into functions and workloads. The total costs incurred were prorated to the workloads on the basis of the criteria previously discussed. To summarize, the functional relation for the total EAM long- and short-run rental costs is:

$$T_s = T_l = 0.0243A_h + 0.206A_p + 0.166M_h + 0.472M_p + 67,894_{nm}$$

where T_s = total short-run annual EAM rental costs, in dollars,
T_l = total long-run annual EAM rental costs, in dollars,
and where the other symbols are as shown in the list given in the front of this volume.

C. Labor Costs

1. General

Labor costs are the largest single category of costs in the Data Processing Division, amounting to over one million dollars annually. Unfortunately, no breakdown of effort by function is available for the branches in the division. However, on a division basis, these breakdowns are available and will be used.

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1 Most of this extra-shift utilization is a function of NSD Mechanicsburg Stock Control, which under normal circumstances must be accomplished at night anyway. Therefore, the charges for this time will be considered part of the average unit cost.

Table X-C

EAM machine hours and rental fees

Fiscal 1960	Basic-shift hours	Extra-shift hours	Total hours	Basic fee	Extra-shift fee	Total rental fee
1st Quarter	33,969	9,518	43,487	$33,159	$1,437	$34,596
2nd Quarter	39,546	7,787	47,333	38,301	512	38,813
3rd Quarter	39,546	7,228	46,774	41,332	250	41,582
4th Quarter	39,546	6,881	46,427	40,983	464	41,447
	Total rental fee, fiscal 1960 = $156,438					
	Total hours, fiscal 1960 = 184,021					
	Average hourly cost = $0.850					
Fiscal 1961						
1st Quarter	42,081	9,088	5,169	$40,647	$783	$41,430

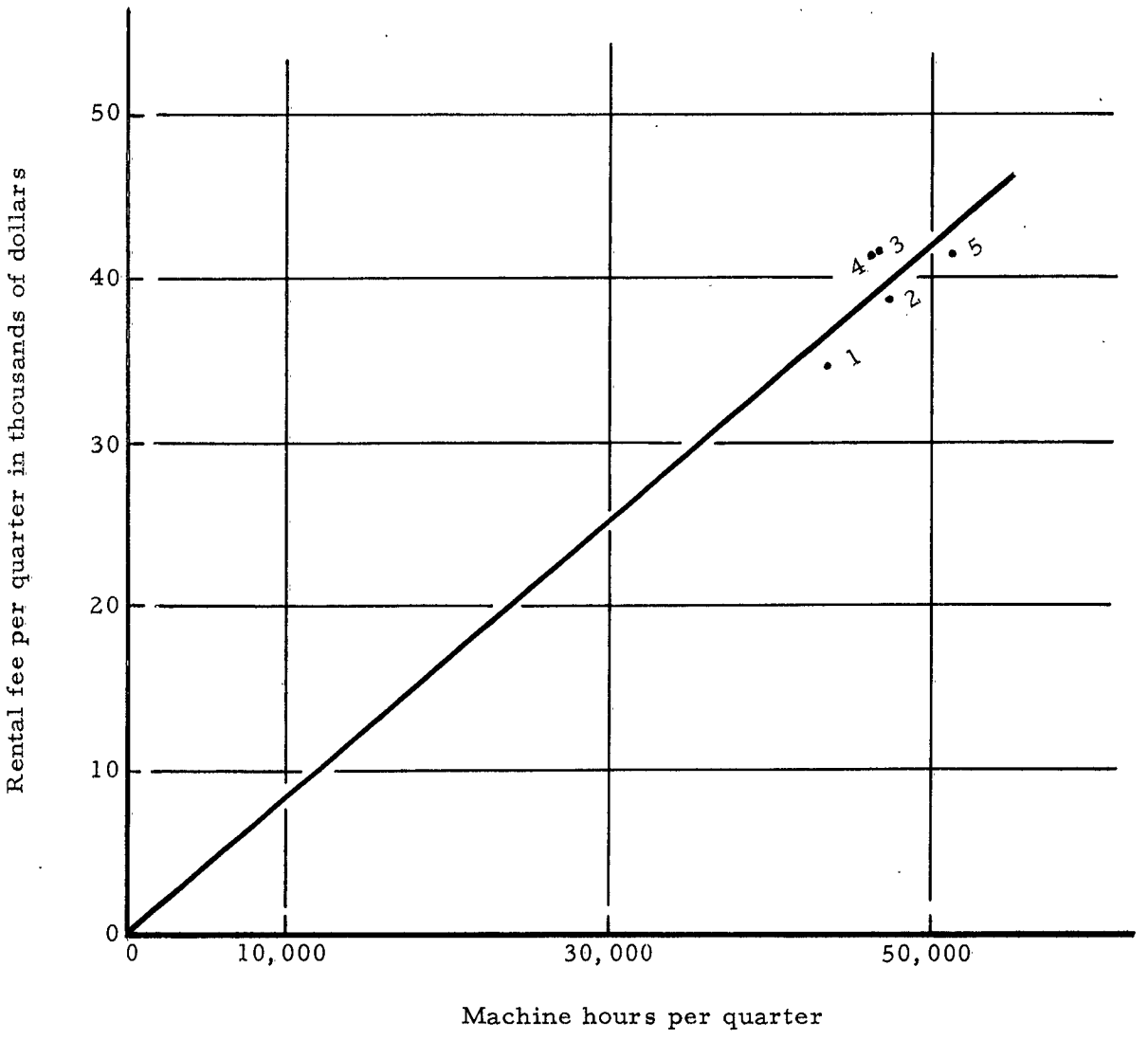

Figure X-B. EAM rental fee vs. machine hours by quarters--fiscal year 1960 and first quarter of 1961.

Table X-D

EAM functions, workloads and rental costs

	SPCC	Technical	Subarpso		NSD	Total
Staffing[1]	8	8	15		24	55
Key Punch Prorated[2]	8	7	14		22	51[1]
Total by function	16	15	29		46	106
Per cent of total	15.1	14.2	27.3		43.4	100
EAM rental costs by functions[3]	$23,622	$22,214	[$21,354[4]	$21,354[4]]	$67,894	$156,438[5]
Workload variables corresponding to functions[6]	A_h	M_h	A_p	M_p		
Constant workloads corresponding to functions					Subscript nm	
Annual workload[7]	973,140	133,443	103,620	45,257		
Unit Cost	$0.0243	$0.166	$0.206	$0.472		

(1) Staffing based on SPCC Manpower Listing, SECNAVINST 5320.4, 31 March 1960.

(2) Prorated on basis of the four groups above.

(3) Based on percentages above, applied to total cost.

(4) Based on an equal assignment to technical and inventory operations for Subarpso.

(5) From Table X-C.

(6) The correspondence between workloads and functions was based on criteria stated in text.

(7) See footnote (5), Table X-B.

2. Man-Hours

Table X-E shows a list of the work measurement codes and the man-hours charged to each for fiscal 1960. It also shows for each of the work measurement functions the corresponding workload of interest defined in detail in Chapter III, Section B.2 of Volume I. These assignments are again based on an analysis of underlying tasks, gleaned from job descriptions, procedures, organization manuals and interview data. In the case of those workloads which will be considered constant, the hours charged to Subarpso are broken out. If a function which is not constant is charged to both H- and P-cog, the measure of the workload variable includes both H- and P-cog.

Some adjustments to the assignments made in Table X-E were made. It was assumed that all personnel at the division staff level, and at the branch staff level, were fixed. Where branch staffs were not specified in the organization manual, the branch supervisor and one clerk were assumed fixed. Some 16 people fall into this fixed category in the Data Processing Division. This is the equivalent of 28,144 man-hours, of which only 16,562 (Functions 101 and 108) are charged on the distribution in Table X-E.[1] The remaining 11,582 are hours which were charged to the major functions under the present system. (These major functions are 622, 631 and 671, or Supply-Demand Review, Item Application Analysis, and Allowance List Development, respectively.) The 11,582 will be prorated and subtracted from these three functions. The net adjustments to these functions then result in the following man-hours, respectively:

Functions	Man-hours
622	69,842
631	49,355
671	37,088
Fixed	28,144

3. Labor Cost Per Man-Hour

As was stated earlier, for the most part, man-hours are only assignable to functions on a division basis with two notable exceptions, namely, EAM

1 There are 1,759 productive man-hours per man-year (see Chapter VIII, Section B).

Table X-E

"Productive" man-hours and workloads--fiscal year 1960

Function	Title	Total man-hours[1]	P-cog man-hours[1]	Workloads	
				Variables	Constants
101	Management Planning	13,554[2]			Subscript f
108	Training	3,008			Subscript f
602	Project Accounting	1,791	152		Subscripts nh and np
611	Requirements Determination	5,239		$A_h + A_p$	
612	Item Analysis	12,658		$M_h + M_p$	
613	Surplus Disposal	1,775		$M_h + M_p$	
622	Supply-Demand Review	75,019[2]		$A_h + A_p$	
623	Procurement Follow-up	16,427		$C_h + C_p$	
624	Special Planned Supply Support	10,546	1,183		Subscripts nh and np
631	Item Application Analysis	53,015[2]		$M_h + M_p$	
632	Material Identification	3,617		$M_h + M_p$	
633	Preservation and Packaging	34		$M_h + M_p$	
641	Buying Operations	85		$C_h + C_p$	
642	Purchase Document Preparation	1,775		$C_h + C_p$	
643	Contract Administration	10,782		$C_h + C_p$	
662	Simplification	85			Subscript nh
663	Technical Analysis	1,166		$M_h + M_p$	
665	Supply and Technical Data	85		$M_h + M_p$	
671	Allowance List Development	39,833[2]			Subscripts ah and ap
672	Allowance List Maintenance	3,431	9,244		Subscripts ah and ap
673	Fleet Load and Stock List Development	8,044			Subscripts ah and ap
674	Base Load List	896			Subscript ah
682	Descriptive Pattern Processing	3,769		$M_h + M_p$	
683	Reference Item Identification	3,887		$M_h + M_p$	
684	Compilation of Navy Stock List	5,138		$M_h + M_p$	
685	Status Coding	1,065		$M_h + M_p$	
693	Catalog and Inventory "Clean Up"	1,690		$M_h + M_p$	

Table X-E (Continued)

Function	Title	Total man-hours(1)	P-cog man-hours(1)	Workloads	
				Variables	Constants
700	Provisioning	237		$G_h + G_p$	
710	System Planning	3,853			Subscript nh
730	Industrial Mobilization Planning	237			Subscript nh
740	Special Effort	8,923			Subscript nh
EAM	For NSD	79,447			Subscript nm
750	Special Project	1,014			Subscript nh
Total		372,125			

(1) Source: Work sheets on monthly man-months by division adjusted to man-hours, obtained from the Budget and Statistics Branch of the Administrative and Management Planning Division.

(2) See text for adjustments to these figures.

for NSD, and division and branch staff.[1] The average labor costs per man-hour will therefore be developed along these lines. Table X-F shows the development of average labor costs per "productive" man-hour. The three costs are weighted averages for the respective staffs shown. It is perhaps, important to note that small changes in the staffing will have little effect on the weighted averages.

4. Labor Costs and Workloads

The labor hours charged to the various functions corresponding to the workloads of interest in Table X-E are summarized by workload in Table X-G. Average productivities are also calculated. It was assumed that management would act so as to maintain the average productivities observed during fiscal year 1960, if the workload levels were to change, since the average productivities observed appeared to be at a reasonable level. These average productivities are used to estimate unit costs given the average cost per "productive" man-hour. Finally, the total labor costs by workload are summarized at the bottom of Table X-G.

5. Labor Cost Summary

The following long-run cost function summarizes labor cost in the Data Processing Division:

$$T_l = 0.237 A_h + 0.237 A_p + 1.604 M_h + 0.604 M_p + 0.0040 G_h + 0.0040 G_h + 2.282 G_h + 2.282 C_p + 136,731_{ah} + 31,430_{ap} + 85,388_{nh} + 4,539_{np} + 203,384_{nm} + 125,804f$$

where T_l = total annual long-run labor costs in dollars treated in this chapter and where the other symbols are as shown in the list given in the front of this volume.

D. Paper Costs

1. General

The total Data Processing Division cost for paper and supplies during fiscal 1960 was $205,925. Table X-H lists these costs by quarter and by amount

[1] The latter by definition and explicit adjustment of the data.

Table X-F

Labor cost per "productive" man-hour

Grade	Cost per man-hour[2]	Staffing[1]		
		Division and Branch Directors and staff	EAM for NSD	Balance of Data Processing
Lieutenant Commander	$5.82	2		
GS-14	8.07	1		
GS-13	7.11	2		
GS-12	6.09	1		7
GS-11	5.24	1		18
GS-10	4.66			1
GS- 9	4.32		1	12
GS- 8	3.99			1
GS- 7	3.66	1	3	16
GS- 6	3.34			1
GS- 5	3.05	3	3	10
GS- 4	2.72	4		6
GS- 3	2.55	1	1	65
GS- 2	2.39		38	4
Per diem[3]	2.86[4]			3
Total personnel		16	46	144
Average cost per "productive" man-hour		$4.47	$2.56	$3.40

(1) See footnote (1), Table X-D.

(2) For a complete discussion of the development of these costs, see Chapter VIII, Section B.

(3) There are three per diem laborers who handle the stock room and run "bursting" machines which separate multiple copy EDPM print out forms.

(4) This cost is based on an average hourly wage of $2.25 plus an allowance for "nonproductive" time and fringe benefits (see Chapter VIII, Section B).

Table X-G

Data Processing Division--workloads, productivity and labor costs

	Variables				Constants						
	$A_h + A_p$	$M_h + M_p$	$C_h + C_p$	$G_h + G_p$	a_h[6]	a_p[6]	n_h[6]	n_p[6]	n_m[6]	f[6]	Total
Total man-hours[1]	75,081	84,239	29,069	237	40,215	9,244	25,114	1,335	79,447	28,144	372,125
Annual work-load[2]	1,076,760	178,700	43,372	203,909							
Average productivity[3]	14.34	2.12	1.49	860							
Average cost per man-hour[4]	$3.40	$3.40	$3.40	$3.40	$3.40	$3.40	$3.40	$3.40	$2.56	$4.47	
Average unit cost[5]	$0.237	$1.604	$2.282	$0.0040							
Total cost	$255,275	$286,413	$98,835	$806	$136,731	$31,430	$85,388	$4,539	$203,384	$125,804	$1,228,605

(1) From Table X-E, and adjustments in text.

(2) See Footnote (5) Table X-B.

(3) Obtained by dividing total man-hours by annual workload.

(4) From Table X-F.

(5) Average cost per man-hour divided by average productivity.

(6) The symbols are subscripts.

Table X-H

Data Processing Division--paper and supply cost[1]

	EAM	EDPM
1st Quarter	$20,584	$21,235
2nd Quarter	11,042	39,160
3rd Quarter	17,767	31,330
4th Quarter	7,652	57,155
Total Annual Cost	$57,045	$148,880
Total Annual Paper and Supply Costs =	$205,925	

(1) Source: Quarterly Summary of EAM/EDPM Operations; NAVEXOS 2861, 1961.

charged to EAM and EDPM operations. In general, paper and supply costs will be treated as being partially fixed and partially variable in the short run as well as the long run. The consumption of certain paper and supplies is directly variable with workload as the workload is processed. For example, each transaction report requires the use of an IBM card. The resource consumed is, in this sense, variable in the short run. The consumption of other paper and supplies is independent of workloads and so is considered fixed. A more complete discussion of this topic is presented in Chapter XV, Section C.

2. Analysis

Supplies and paper are not charged to functions and no readily apparent method existed for relating these costs to workloads. An attempt to handle this on the basis of an analysis of documents, as was done in the Purchase Division (Chapter XIII), was found infeasible, since the number of cards and forms associated with each document or operation involved considerable variation.

Looking at the relationship of costs and volume with time also proved of little use, since a detailed analysis of the costs by quarter shows that they are quite erratic, indicating the possibility that considerable stockpiling takes place. Visual inspection of the operations tends to bear this out.

However, a reasonable means for the assignment of these costs to workloads was chosen. It was assumed that the amount of paper and supplies used would, in the aggregate, be proportional to machine hours. That is, the consumption of these supplies was a direct function of machine hours. The validity of this assumption was supported by discussions with operating personnel.

Employing the above assumption, EAM supply costs were prorated using the EAM machine rental percentage breakdown by workloads and EDPM supply costs were prorated using the EDPM percentage breakdown by workloads. Table X-I and Table X-J show this. Table X-K summarizes the unit variable costs and constant cost components developed in the previous two tables.

To summarize in the form of a functional relationship, the total paper and supply costs for the Data Processing Division can be written:

$$T_l = T_s = 0.054 A_h + 0.215 A_p + 0.262 M_h + 0.373 M_p$$

$$+ 37,190_{ah} + 8,159_{ap} + 9,499_{nh} + 24,758_{nm}$$

where

T_l = the total long-run annual costs of paper and supplies, in this division, in dollars

T_s = the total short-run annual costs of paper and supplies, in this division, in dollars

and the other symbols are as shown in the list given in the front of this volume.

E. Cost Models

1. General

Four functional relations for costs have been presented in this chapter. These include EDPM rental costs, EAM rental costs, labor costs, and paper and supply costs. These four models are recapitulated in Table X-L.

2. Short-Run Costs

Machine rental costs and paper and supply cost are treated as variable in the short run. All labor costs are treated as fixed in the short run. Thus, the total short-run cost is the sum of the four functional relationships treating labor cost as fixed. The coefficients are summarized in Table X-L. The short-run cost model is:

Table X-I

EAM workloads and paper and supply costs

	Workloads					
	Variables				Constants	
	A_h	M_h	A_p	M_p	Subscript nm	Total
% of rental hours corresponding to workload[1]	15.1	14.2	13.7	13.6	43.4	100
Paper and supply cost assigned to workload[2]	$ 8,614	$ 8,100	$ 7,815	$7,758	$24,758	$57,045[3]
Annual workload[4]	973,140	133,443	103,620	45,257		
Unit cost	$0.0089	$0.0607	$0.0754	$0.1714		

(1) From Table X-D.

(2) Based on percentage of total cost from above.

(3) From Table X-H.

(4) See footnote (5), Table X-B.

Table X-J

EDPM workloads and paper and supply costs

	Workloads						
	Variables			Constants			
	M_h+M_p	A_h	A_p	Subscript ah	Subscript ap	Subscript nh	Total
% of rental hours corresponding to workload(1)	24.18	29.30	9.68	24.98	5.48	6.38	100
Paper and supply cost assigned to workload(2)	$35,999(3)	$43,622	$14,411	$37,190	$8,159	$9,499	$148,880(4)
Annual workload(5)	178,700	973,140	103,620				
Unit cost	$0.2014	$0.0448	$0.1391				

(1) From Table X-B.

(2) Based on percentages of total cost from above.

(3) The $35,999 can be divided into $26,879 H-cog and $9,120 P-cog based on the relative sizes of the workloads for each cog.

(4) From Table X-H.

(5) See footnote (5), Table X-B.

Table X-K

Data Processing Division--summary of workloads and paper and supply costs

Workloads	Unit cost[1]	Total cost[1]
Variables		
A_h	$0.0537	$52,236
A_p	0.2145	22,226
M_h	0.2621	34,979
M_p	0.3728	16,878
Constants		
Subscript ah		37,190
Subscript ap		8,159
Subscript nh		9,499
Subscript nm		24,758
		$205,925

(1) From Tables X-I and X-J.

Table X-L

Recapitulation of cost model coefficients
(For footnotes see next page)

	Workload variables							
	A_h	A_p	C_h	C_p	C_h	G_p	M_h	M_p
EDPM rental	$0.069	$0.215					$0.312	$0.312
EAM rental	0.024	0.206					0.166	0.472
Paper & supplies	0.054	0.215					0.262	0.373
Labor costs	0.237	0.237	2.282	2.282	0.004	0.004	1.604	1.604
Total short run(1)	0.147	0.636					0.740	1.157
Total long run(2)	0.384	0.873	2.282	2.282	0.004	0.004	2.344	2.761

Table X-L (Continued)

	Workload constants						
	Subscript ah	Subscript ap	Subscript nh	Subscript np	Subscript nm	Subscript f	Total
EDPM rental	$57,534	$12,630	$14,691			$602,520	$ 832,854
EAM rental					67,894		156,438
Paper & supplies	37,190	8,159	9,499		24,758		205,925
Labor costs	136,731	31,430	85,388	4,539	203,384	125,804	1,228,605(3)
Total short run(1)	94,724	20,789	24,190		92,652	1,831,125	2,423,822
Total long run(2)	231,455	52,219	109,578	4,539	296,036	728,324	2,423,822

(1) Sum of lines 1, 2, and 3 plus total labor cost.

(2) Sum of lines 1, 2, 3, and 4.

(3) Note the difference between this cost and that shown on Data Processing Reports to Busanda is due to: a) fringe benefits, b) inclusion of "nonproductive" labor and leave time, and c) provision in average cost for pay increase effected July '60.

$$T_s = 0.147A_h + 0.636A_p + 0.740M_h + 1.157M_p + 94,724_{ah}$$

$$+ 20,789_{ap} + 24,190_{nh} + 92,652_{nm} + 1,831,125_f$$

where T_s = the total short-run dollar costs treated in this chapter, and where the other symbols are as defined at the beginning of this volume.

3. Long-Run Costs

All of the cost categories treated in this chapter are considered variable in the long-run. The cost coefficients of the long-run cost model are summarized in Table X-L. The total long-run cost model is:

$$T_l = 0.384A_h + 0.873A_p + 2.28C_h + 2.28C_p + 0.004G_h$$

$$+ 0.004G_p + 2.344M_h + 2.761M_p + 231,455_{ah} + 52,219_{ap}$$

$$+ 109,578_{nh} + 4,539_{np} + 296,036_{nm} + 728,324_f$$

where T_l = the total annual long-run dollar costs treated in this chapter, and where the other symbols are as shown in the list given in the front of this volume.

F. Elapsed Times

In this discussion elapsed time to process replenishment recommendations in the Data Processing and Stock Control Divisions will be considered. Replenishment recommendations, or R.R.'s, arise out of the process which starts with the receipt of transaction reports. From transaction reports and the perpetual inventory record, a supply-demand review is made by EDPM and action forms are produced. The action forms are reviewed by Stock Control and returned to Data Processing, and R.R.'s are turned out. These are again reviewed by Stock Control and then released to the Technical Division and the Financial Control Division. The elapsed times in these divisions are treated in the discussions of the respective divisions. The elapsed times discussed here begin with the time that the transaction reports are received and end with the time that the R.R.'s are released to the Technical and Financial Control Divisions.

The factors which affect the elapsed times considered in this section are different from those which are considered elsewhere in this report in that all processing is organized according to fixed time schedules. Transaction reports are received continuously. Under the operating procedures in effect

since September 1960, a supply-demand review is made every 2 weeks.[1] Thus, the distribution of elapsed times incurred before transaction reports are used for a supply-demand review is rectangular, with a range of from 0 to 14 days. The average elapsed time is 7 days.

Under present operating procedures, the time required to complete a supply-demand review is 18 days. This includes the time from the cutoff date for receipt of transaction reports to the date that the verified R.R.'s are released to the Technical and Financial Control Divisions. This elapsed time does not vary between R.R.'s since the R.R.'s are released in a batch. It also does not vary appreciably between supply-demand reviews. However, the interviews and observations of the research team indicate that the number and the thoroughness of the stock reviews made by the stock analysts in the Stock Control Division do vary. Below is a typical schedule for one supply-demand review:

Week 17, Fiscal Year 1961

14 October	Cutoff date: EAM transaction reports
17 October	Sort
19 October	Consolidated stock status reports (CSSR's) and action forms go to Stock Control
25 October	Action forms go back to Data Processing
1 November	Release of R.R.'s to Technical

The combined average elapsed time for R.R.'s through Data Processing and Stock Control may be expressed mathematically as follows:

$$t_2 = \frac{V_1}{2} + V_2$$

where t_1 = average elapsed time in calendar days for R.R.'s through Data Processing and Stock Control,

[1] Actually the stock list is divided into "slow fraction" and "fast fraction" items, and each fraction is reviewed on alternate weeks.

V_1 = number of days between the beginning of two consecutive supply-demand reviews for the same fraction of items,

V_2 = number of days between the cutoff date for the receipt of transaction reports for a particular supply-demand review and the date that the verified R. R. 's are released to the Technical Division.

Under current operating procedures V_1 equals 14 days, V_2 equals 18 days, and, therefore, t_2 equals 25 days.

The distribution of elapsed times is approximately rectangular with a range from V_2 days to $V_1 + V_2$ days, or, under current operating procedures, from 18 days to 32 days.

XI. TECHNICAL DIVISION

A. Description

1. General

The Technical Division is the largest division at SPCC. It employs approximately 520 people, or about 35 to 40 per cent of the total work force at SPCC. It furnishes technical support for all of the major SPCC functions including purchasing, stock control, provisioning, and the preparation of allowance and load lists. The division also provides services to Subarpso which supplement the work of Subarpso's Technical Division. Extensive technical files and records are maintained.

The Technical Division has eight branches, which include the Military Assistance Program (MAP) Branch, the Document Analysis and Records Branch, the Research Branch, the Item Description and Preservation Branch, and four Material Determination Branches. The activities of each of these branches are discussed below.

2. MAP Branch

The Military Assistance Program (MAP) Branch employs about 40 people. It determines technical requirements for repair parts to be carried as shore based spares for support of ex U.S. Navy ships transferred to foreign governments under the Military Assistance Program. It determines such factors as essentiality, wearing rate, replacement possibilities, feasibility of fabrication, and substitutability. All of the work is done at night when the other branches are not working. The workload of this branch is independent of the decision alternatives with which this report is concerned.

3. Document Analysis and Records Branch

The Document Analysis and Records Branch employed 91 people as of 9 November 1960. This represents a reduction of about 25% from the levels that prevailed during most of fiscal year 1960. The branch processes requisitions for H-cog material in order to identify items, to recommend substitute items, to prepare purchase specifications and descriptions, and to recommend procurement action and method of supply when appropriate. All requisitions which are received by the Stock Control Division and which require some technical work other than that normally required for procurement

action are sent to this branch for processing. This includes most, but not all, of the passed requisitions received by Stock Control. The branch does not provide services to Subarpso.

The Document Analysis and Records Branch maintains the Technical Division's Master Technical Records file. It processes surplus lists, unidentified material lists, and allowance lists for identification from established technical data. It furnishes information to other branches pertaining to provisioning decisions. The branch is also responsible for the scheduling of Allowance Parts List (APL) preparation.

4. Research Branch

The Research Branch has about 45 employees. Most of its work is independent of the decision alternatives with which this report is concerned. As of this writing its major functions are concerned with the Accelerated Item Reduction (AIR) Program to reduce the number of H-cog items required in the Navy supply system, and with the planning, supervision, and coordination of the Department of Defense program to reduce the number of specifications, and to standardize specifications, under which bearings are purchased. The branch reviews H-cog items proposed for addition to the stock list to insure maintenance of standardization. The branch does very little work for Subarpso.

5. Item Description and Preservation Branch

a. Preservation and Packaging Section

The Preservation and Packaging Section develops and compiles preservation, packaging, packing, and marking requirements for all items under the inventory management of SPCC and Subarpso. It recommends the acceptability of deviations from such requirements and recommends changes in the requirements as appropriate. It also develops weight and cube information. All H-cog and P-cog requisitions and replenishment recommendations (R. R. 's) requiring purchase action are reviewed by this section before going to the Purchase Division for procurement. The section has approximately 17 people.

b. Other Sections

The Item Description and Preservation Branch employs about 85 people exclusive of those in the Preservation and Packaging Section. It develops description patterns, prepares item identifications, determines

equivalency, and develops purchase descriptions for items under the inventory control of SPCC and Subarpso. All R.R.'s for H-cog material are sent to a Control Unit in this branch. R.R.'s which are for less than $2,000 and which contain complete technical data (e.g., part numbers, contractor numbers, specifications, etc.) are forwarded directly to the Preservation and Packaging Section, which reviews them and forwards them to the Purchase Division. The other R.R.'s are segregated into those which are for components[1] and those which are for parts. The R.R.'s for components are sent to the Material Determination Branches for processing. The R.R.'s for parts are processed by equipment specialists in the Item Description and Preservation Branch. After the R.R.'s have been reviewed and any required technical information added, they are sent to the Preservation and Packaging Section for review and then returned to the Control Unit, which forwards them to the Purchase Division.

All R.R.'s and purchase requisitions for P-cog material are sent to the Control Unit and then forwarded to the equipment specialists in the Item Description and Preservation Branch for processing. Thus, they are handled in much the same way as H-cog R.R.'s for parts which require processing by the equipment specialists. The number of P-cog purchase requisitions is small in relation to the number of P-cog R.R.'s. Also the processing of P-cog purchase requisitions does not differ importantly from the processing of P-cog R.R.'s. Identical forms are often used. Requisitions for P-cog material are processed by Subarpso's Technical Division before they are sent to SPCC.

The Item Description and Preservation Branch maintains extensive files covering both H-cog and P-cog materials. It coordinates the submittal of data in the Federal Catalog program. It obtains or assigns stock numbers for items under the cognizance of SPCC and Subarpso. It also maintains liaison with the Armed Forces Supply Support Center (AFSSC).

6. Material Determination Branches

There are four Material Determination Branches: the Engine and Gear Branch, the Electrical Branch, Machinery Branch, and the Mechanical Branch. All branches perform substantially similar functions. They differ primarily in the types of material for which they are responsible. Altogether, the Material Determination Branches have about 220 employees.

[1] A component is defined as a major equipment or assembly composed of many parts, such as a diesel engine or a laundry machine.

The Material Determination Branches determine technical requirements for the provisioning and Allowance Parts Lists Programs on a project basis. They determine interchangeability and the acceptability of substitutes, select items for intercog transfer, prepare new equipment specifications, and recommend modifications of existing specifications.

All H-cog R.R.'s for components which are for more than $2,000 or which require the addition of certain technical data are processed by the Material Determination Branches. They furnish, modify, or approve exceptions to procurement specifications as appropriate. In addition, these branches participate in standardization studies and provide technical data for the records. The Material Determination Branches do not handle items under the inventory management of Subarpso.

There are some differences between the Material Determination Branches. For example, the Engine and Gear Branch has more extensive files than the other branches. Also the Engine and Gear Branch determines the technical requirements for all H-cog material in conjunction with ship alterations, even though other branches are otherwise responsible for certain classes of the material.

7. Work Flows

After R.R.'s have been prepared by the Data Processing Division, copies are routed to the Control Unit of the Item Description and Preservation Branch where they are sorted and routed to the appropriate groups (see Section 5, above) for review. They are then returned to the Control Unit, which forwards them to the Purchase Division.

Requisitions, which are sent to the Technical Division by the Stock Control Division, are processed entirely within the Document Analysis and Records Branch. They are received and sorted by the Document Control Unit. They are then forwarded to the appropriate material sections which provide the necessary technical information, returned to the Document Control Unit, and forwarded to the Stock Control Division or to the Purchase Division, as appropriate.

Provisioning documents are sent to the Document Control Unit of the Document Analysis and Records Branch, where they are logged in, sorted, and routed to the appropriate Material Determination Branches. The Material Determination Branches determine the technical requirements and recommend the number of items to be stocked. The documents are then returned to the

Document Control Unit and forwarded to the appropriate divisions. Other branches of the Technical Division are also involved in the processing of provisioning documents.

A detailed diagram showing work flows in the Technical Division is included in Appendix I.

B. Labor Costs

1. Workloads

The workload variables that are pertinent for the Technical Division are described in the following paragraphs.

C_h - Replenishment Recommendations, H-cog. All R.R.'s for H-cog material are handled by the Technical Division. Some are handled only by the Control Unit and Preservation and Packaging Section of the Item Description and Preservation Branch before they are forwarded to the Purchase Division. Others are processed by equipment specialists in the Item Description and Preservation Branch and in the Material Determination Branches. It does not appear to be worthwhile to differentiate between various types of R.R.'s. Although R.R.'s arise from different sources, such as supply-demand reviews, provisioning, and the preparation of allowance and load lists, all are handled similarly and will be treated as homogeneous units. During fiscal year 1960, according to the counts made in the Control Unit of the Purchase Division, 31,708 R.R.'s for H-cog material (in line items) were processed.

D_h - Passed Requisitions. This variable includes all passed requisitions received by the Stock Control Division. It does not include requisitions arising from planned programs or special programs such as provisioning, allowance and load list preparation, ship alterations, the Military Assistance Program (MAP), or the Reserve Fleet Deficiency in Allowance Requirements (DIA) Program. The workload corresponding to this variable includes all processing of passed requisitions except any additional processing which may be required if a purchase requisition is prepared. In particular, this variable represents all of the work on passed requisitions which is performed by the Document Analysis and Records Branch. This variable is not used to represent work performed by the Item Description and Preservation Branch.

During fiscal year 1960, according to the SPCC Supply Management Reports - Part I, 121,142 line items on such requisitions were processed by the Stock Control Division. It is assumed that a constant percentage of these were sent to the Document Analysis and Records Branch for identification,

recommendation of substitutes, the preparation of specifications and descriptions, etc.

E_h and F_h - NIS and NSI Purchase Requisitions, H-cog. All purchase requisitions for H-cog material are reviewed by the Preservation and Packaging Section before going to the Purchase Division for procurement. Purchase requisitions are not processed by any other sections in the Technical Division. Although purchase requisitions may arise from several different sources, such as passed requisitions, provisioning, the preparation of allowance and load lists, ship alterations, the MAP Program, and the DIA Program, all are handled similarly and will be treated as homogeneous units. Purchase requisitions for Not-In-Stock items (NIS's) and for Non-Stocked Items (NSI's) are handled in the same way in the Technical Division and, therefore, need not be differentiated. According to the counts made in the Control Unit of the Purchase Division, 33,592 line items on purchase requisitions for H-cog material were processed during fiscal year 1960.

C_p, E_p, and F_p - Replenishment Recommendations and NIS and NSI Purchase Requisitions, P-cog. R.R.'s and purchase requisitions for P-cog material are processed by equipment specialists in the Item Description and Preservation Branch and by the Packaging and Preservation Section. They are not handled in the other branches of the Technical Division. R.R.'s and purchase requisitions for P-cog material are processed in the same way in the Technical Division. Therefore, they will not be differentiated in this analysis. According to the counts made in the Control Unit of the Purchase Division, 12,792 line items on R.R.'s and purchase requisitions for P-cog material were processed during fiscal year 1960. Of these 11,664 were on R.R.'s, 847 were on NIS purchase requisitions, and 281 were on NSI purchase requisitions.

G_h - Provisioning Items, H-cog. The work corresponding to this variable includes all work that results from the receipt of a provisioning document at SPCC except any additional work which may be required if a decision to procure is made and a replenishment recommendation or purchase requisition is prepared. In other words, this variable corresponds to all work related to provisioning except that work which corresponds to the variables for R.R.'s, purchase requisitions, and purchase actions. In particular, this variable represents all of the technical analysis work performed on provisioning projects, much of which is done in the Material Determination Branches. It also represents the cataloging and records maintenance activities which are incurred as a result of provisioning activities. All of the branches in the Technical Division except the MAP Branch are involved in such provisioning work.

The measure used for the provisioning variable is the count reported in the SPCC Supply Management Report - Part I. This is the number of different line items on provisioning forms which are reviewed for determination of range and depth of items required to support an end item. It includes items to be added to the Navy Supply System, items requiring supply support action by another ICP, and items which are not required in the Navy Supply System. The counts are made and reported by the Material Determination Branches. During the 1960 fiscal year, 144,278 provisioning items were processed.

G_p - Provisioning Items, P-cog. This variable has a meaning analogous to the provisioning variable for H-cog. However, since Subarpso does most of the technical analysis on P-cog provisioning projects, the work corresponding to this variable consists primarily of cataloging and records maintenance activities. The Item Description and Preservation Branch is the only branch in the Technical Division that is involved in this work. During fiscal year 1960, as reported in Subarpso Supply Management Report - Part I, 59,631 provisioning line items were processed.

M_h - Stock List, H-cog. A fairly sizable portion of the workload of the Technical Division consists of answering miscellaneous requests, cataloging, and maintaining records and files. Much of this work does not vary with the workload variables which have been discussed above or with planned programs or special programs. However, much of the work does depend upon, and vary more or less directly with, the number of line items on the stock list. Since the size of the stock list can vary over time and could be affected by decision alternatives of interest to the users of this report, it is included as a workload variable.

All of the branches of the Technical Division except the MAP Branch are involved in work which is related to the size of the stock list. However, such work is particularly large in the branches which maintain extensive records and files. The size of the stock list for H-cog materials on 30 September 1960, as measured by standard stock numbers on the Navy Stock List and reported in the SPCC Supply Management Report - Part I, was 133,443 items.

M_p - Stock List, P-cog. This variable has a meaning analogous to the stock list variable for H-cog. However, most of the work which varies with the size of the P-cog stock list is handled by Subarpso. The Item Description and Preservation Branch, which maintains files containing information on P-cog items, is the only branch in the Technical Division that is involved in this work. The size of the stock list for P-cog materials on 30 September 1960, as measured by standard stock numbers on the Navy Stock List and reported in the Subarpso Supply Management Report - Part I, was 45,257 items.

The workload constants which are pertinent for the Technical Division are described below.

Subscript ah - Allowance and Load Lists, H-cog. Much of the workload in the Technical Division is independent of the decision alternatives of interest in this report. The costs resulting from such workloads are included in this study but are treated as constant. In general, such costs are not segregated as to type of workload. However, the costs which result from the Allowance and Load List Program are segregated into a special category since they comprise much of the total and since they are pertinent for certain classes of decisions. This category includes the cost of all analysis, cataloging, and records maintenance work associated with and incurred as a result of the preparation of Shipboard Allowance Lists, Revised Individual and Type Allowance Lists, Allowance Parts Lists, Ship-to-Component Records, and Load Lists for H-cog material. The Material Determination Branches and the Document Analysis and Records Branch are branches in the Technical Division which are primarily involved in these programs.

Subscript nh - Nonpertinent Workloads, H-cog. The costs included in this category consist of all costs resulting from H-cog workloads which are independent of the decision alternatives of interest in this study except the costs associated with Allowance and Load List Programs. In particular, it includes costs which result from MAP and DIA requisitions, ship alterations, the AIR Program, the Bearing Standardization Program, the Federal Catalog Program, the Industrial Mobilization Program, and other special programs and studies. It does not include costs associated with processing purchase requisitions or replenishment recommendations even though they may arise as a result of certain of these programs. All of the branches in the Technical Division are involved in processing nonpertinent workloads to some extent. However, the MAP Branch and the Research Branch are especially involved.

Subscript np - Nonpertinent Workloads, P-cog. This category of cost has a meaning analogous to the nonpertinent workloads category for H-cog. The amount of such costs incurred by the Technical Division is very small and occurs principally in the Item Description and Preservation Branch.

Subscript f - Fixed Costs. This category includes all costs that are considered to be independent of workloads over the range of workloads of interest. That is, it includes costs which are expected to remain constant, even in the long run, over a fiarly wide range of workloads. Such costs might be expected to change in the long run for extreme changes in workload, such as reduction to zero or an increase of 100%. However, for reasonable changes in

total workload at SPCC, changes of, say 50% in either direction, they may be considered fixed. Since this category is independent of changes in workloads, no distinction is made between SPCC and Subarpso.

Personnel in the Technical Division who are assumed to be fixed include the division director and his immediate support staff, the branch directors, the highest ranking civilian in each of the branches (who may be the branch director), and one clerk in each of the branches. All other personnel in the Technical Division are assumed to be variable in the long run.

2. Man-Hours

a. Method of Estimation

Each of the branches in the Technical Division has many different types of workload which differ in priorities. A change in one workload may not significantly change staffing levels, productivity, or quality of performance because personnel may be shifted to or from another workload which may have lower priority but a large backlog. For example, if there is a decline in the number of R. R. 's received, more DIA requisitions (of which there is a large backlog and which are given lower priority) may be processed, or deferred maintenance of files may be performed. The reverse may be true if there is an increase in the number of R. R. 's received. In any case, personnel are kept busy and productivity rates for any given workload variable remain fairly stable.

During the course of this study no major shifts in workload levels were observed. However, there was a major change in the staffing level of one of the branches. The number of employees in the Document Analysis and Records Branch declined from about 132 during most of fiscal year 1960 to 91 people as of 9 November 1960. There was no corresponding change in either workload input or output. In other words, productivity rates increased to compensate for the decline in staffing.

It is felt that estimates of future average labor productivity in the Technical Division should be based on current staffing levels and current workloads rather than on the basis of average historical productivity. This is equivalent to saying that the most reasonable assumption is that management will act so as to maintain present levels of productivity. In this study, the staffing levels as of 9 November 1960 are used. Current workloads are, in general, measured by actual workloads during fiscal year 1960, which is a sufficiently long period to nullify seasonal and random fluctuations and which appears to be representative of current workloads.

b. Man-Hours Associated with Workloads

In order to determine the "productive" man-hours associated with each of the workloads in the Technical Division, the monthly Work Measurement Reports submitted to the Technical Division Director by each of the branches in the division were analyzed in detail. The man-hours charged by each branch to each of the functions and subfunctions were summed for fiscal year 1960. This was done separately for SPCC work and for Subarpso work, since the branches submit separate monthly reports covering SPCC and Subarpso activities. The man-hours obtained were then assigned to the workload variables and constants used in this report. The assignments were made on the basis of discussions with Technical Division personnel and information contained in Technical Division instructions. The correspondence between the function numbers used in the Technical Division and the variables and constants used in this report is shown in Table XI-A. The complete title and definition of each function may be found in the SPCC Technical Division Instruction 5220.5A, dated 12 July 1960. The symbols shown in Table XI-A do not distinguish between H-cog and P-cog workloads. These distinctions were based upon whether the Branch Work Measurement Reports were for SPCC activities or for Subarpso activities.

The total "productive" man-hours corresponding to each of the workloads during fiscal year 1960, as thereby obtained, were adjusted to obtain estimates of current annual "productive" man-hours corresponding to each workload. These adjustments were necessary for two reasons. First, for the reasons explained in the preceding section, it was necessary to adjust total man-hours to current staffing levels rather than to use the staffing levels during fiscal year 1960. Second, the man-hour data included the time of certain personnel who are treated in this analysis as fixed. The method by which these adjustments were made is described below.

The total "productive" man-hours corresponding to each of the workloads were converted to percentages. This was done separately for each branch. The results are shown in Table XI-B.

The number of employees corresponding to each of the workloads in each of the branches was then estimated. The total staffing level in each branch was assumed to be the on-board staffing level (including military personnel) on 9 November 1960. The number of fixed personnel assumed for each branch was as stated in Section B.1 of this chapter. The remaining personnel in each branch were assumed to be variable and were assigned to the workload variables and constants on the basis of the percentages shown in

Table XI-A

Correspondence of Technical Division functions to workload variables and constants

Technical Division function number	Title of Technical Division function	Corresponding workload symbol[1]
Administration		
108	Training	omitted
Item Application Analysis		
631A	Part/Item Application to Component	subscript a
631B	Failure Rate and Basic Usage Factor	G
631C	Specification/Description Review	G
631E	Requirements Determination	subscript n
631F	Item Analysis	subscript a
631G	Maintenance of Master Technical Files	M
631H	Cognizance Transfers	G
631I	Industrial Mobilization	subscript n
631J	Clerical, Correspondence, and Typing	proportional to man-hours charged to other subfunctions of function 631
631K	Supervision	
631L	Planned Requirements	subscript n
631M	Miscellaneous Requests	M
Material Identification		
632A1	Requisitions other than DIA	C or D, depending on branch
632A2	DIA Requisitions	subscript n
632B	Identification	M
632C1	Furnishing Established Specifications	C, C+E+F for Subarpso

(1) See Section B.1 of this chapter for meaning of symbols.

Table XI-A (Continued)

Technical Division function number	Title of Technical Division function	Corresponding workload symbol
Material Identification (Continued)		
632C2	Initiating Purchase Description for Codes 740 and 770	C, C+E+F for Subarpso
632C3	Initiating Purchase Description for New Items	G
632C4	Initiating Purchase Description for Code 736	C
632C5	Amending Established Purchase Description	C, C+E+F for Subarpso
632D	Source and Quantity Determinations	C
632E	Contract Administration	C or D, depending upon branch, C+E+F for Subarpso
632G	Clerical, Correspondence and Typing	proportional to man-hours charged to other subfunctions of function 632
632H	Supervision	
632I	Miscellaneous Requests	M
Preservation and Packaging		
633A	Packaging Determinations	G
633B	Deck Maintenance	M
633C	Purchase Referrals	C+E+F
633D1	Furnishing Contract Requirements	E+F, C+E+F for Subarpso
633D2	Developing Contract Requirements	C+E+F
633E	Specification Review	M
633F	Discrepancy Action	C+E+F
633G1	Weight and Cube Computation	G
633G2	Furnishing Established Weight and Cube	M

Table XI-A (Continued)

Technical Division function number	Title of Technical Division function	Corresponding workload symbol
Preservation and Packaging (Continued)		
633H	Liaison	proportional to man-hours charged to other subfunctions of function 633
633I	Clerical, Correspondence, and Typing	
633J	Supervision	
Standardization		
662	Simplification	subscript n
663	Technical Analysis	subscript n
664	Document Projects	subscript n
Allowance and Load Lists		
671	Allowance List Preparation	subscript a
Cataloging		
681	Descriptive Pattern Processing	proportional to man-hours charged to functions 682 and 683
682A1	Routine New Descriptive Item Identifications	M
682A2	New Provisioning Descriptive Item Identifications	G
682B1	Routine Revised Descriptive Item Identifications	M
682B2	Revised Provisioning Descriptive Item Identifications	G
682C	Numbering, Classification, and File Maintenance	M
683A1	Routine Reference Item Identifications	M

Table XI-A (Continued)

Technical Division function number	Title of Technical Division function	Corresponding workload symbol
Cataloging (Continued)		
683A2	Provisioning Reference Item Identifications	G
683B	Numbering, Classification, and File Maintenance	M
684	Compilation and Distribution	M
AIR Program		
691	Status Coding	subscript n
693	Catalog and Inventory Cleanup	subscript n
Provisioning		
700	Provisioning	G
Special Projects		
750	Special Projects	subscript n

Table XI-B

Per cent of total "productive" man-hours corresponding to workloads by branch

Workload symbol	Branch			
	MAP	Engine and Gear	Document Analysis and Records	Research
Variables				
C_h	-	7.701	-	-
D_h	-	-	50.869	-
$E_h + F_h$	-	-	-	-
$C_p + E_p + F_p$	-	-	-	-
G_h	[illegible]	14.031	6.487	4.165
G_p	-	-	-	-
M_h	[illegible]	25.920	23.584	12.163
M_p	-	-	-	-
Constants				
Subscript ah	-	29.766	15.102	-.007
Subscript nh	100.000	22.582	3.958	83.338
Subscript np	[illegible]	-	-	0.327
Total	100.000	100.000	100.000	100.000

Workload symbol	Branch				
	Item Description and Preservation				
	Packaging & Preservation	Other	Electrical	Machinery	Mechanical
Variables					
C_h	12.174	22.788	10.285	7.860	16.827
D_h	-	-	-	-	-
$E_h + F_h$	20.453	-	-	-	-
$C_p + E_p + F_p$	5.823	19.541	-	-	-
G_h	25.955	8.980	25.777	26.121	27.082
G_p	23.000	7.157	-	-	-
M_h	11.212	25.228	11.781	11.671	14.997
M_p	1.383	4.199	-	-	-
Constants					
Subscript ah	-	0.197	50.470	51.384	39.402
Subscript nh	-	10.331	1.687	2.964	1.692
Subscript np	-	1.579	-	-	-
Total	100.000	100.000	100.000	100.000	100.000

Table XI-B. Table XI-C shows the estimated staffing levels by branch. The estimated current annual "productive" man-hours corresponding to each of the workloads is 1759 times the staffing levels (see Chapter VIII, Section B of this report).

3. Labor Costs per Man-Hour

Average labor costs per "productive" man-hour were estimated separately for each of the branches. These estimates did not include fixed personnel. A separate estimate was made of average labor costs per "productive" man-hour for all personnel in the division that were assumed to be fixed.

Table XI-D shows the estimated labor costs per "productive" man-hour. The first column shows the grades of the employees. The second column shows the estimated current average labor cost for each grade. The figures shown in Chapter VIII, Section B, of this report were used. They include allowances for "nonproductive" labor and fringe benefits. The remaining columns show the assumed manning for each branch. The assumed manning figures were taken from the official SPCC manpower listings as of 31 March 1960.[1] They were used as weights to obtain the estimated average labor cost per "productive" man-hour for each branch. The estimated labor costs per "productive" man-hour for each branch are shown in the last row of the table.

4. Labor Costs Corresponding to Workloads

The estimated total labor cost, at current annual rates, corresponding to each of the workloads was estimated by branch from Tables XI-C and XI-D. The staffing estimates shown in Table XI-C were convered to "productive" man-hours per year by multiplying through by 1759 (see Chapter VIII, Section B, of this report). The resulting man-hour figures in each branch were then multiplied by the average labor cost per "productive" man-hour for the branch, as shown in Table XI-D. The current annual labor costs by workload by branch thereby obtained are shown in Table XI-E. The column at the right of the table shows the estimated total annual labor costs for each workload in the Technical Division.

[1] These figures are not the same as the staffing figures used to estimate man-hours in each branch.

Table XI-C

Number of employees corresponding to workloads by branch

Workload symbol	Branch: Div. dir. and support staff	MAP	Eng. and Gear	Docu. Anal. and Recs.	Research
Variables					
C_h	-	-	2.695	-	-
D_h	-	-	-	44.764	-
E_h+F_h	-	-	-	-	-
$C_p+E_p+F_p$	-	-	-	-	-
G_h	-	-	4.911	5.709	1.833
G_p	-	-	-	-	-
M_h	-	-	9.072	20.754	5.351
M_p	-	-	-	-	-
Constants					
Subscript ah	-	-	10.418	13.290	.003
Subscript nh	-	38.000	7.904	3.483	36.669
Subscript np	-	-	-	-	0.144
Subscript f	22.000	2.000	2.000	3.000	2.000
Total	22.000	40.000	37.000	91.000	46.000

Workload symbol	Branch: Item Description and Preservation Pack. & Pres.	Other	Electrical	Machinery	Mechanical	Total Tech. Div.
Variables						
C_h	2.070	18.458	6.994	3.301	11.611	45.129
D_h	-	-	-	-	-	44.764
E_h+F_h	3.477	-	-	-	-	3.477
$C_p+E_p+F_p$	.990	15.828	-	-	-	16.818
G_h	4.412	7.274	17.528	10.971	18.687	71.325
G_p	3.910	5.797	-	-	-	9.707
M_h	1.906	20.438	8.011	4.902	10.348	80.779
M_p	0.235	3.401	-	-	-	3.636
Constants						
Subscript ah	-	0.160	34.320	21.581	27.187	106.959
Subscript nh	-	8.368	1.147	1.245	1.167	97.983
Subscript np	-	1.279	-	-	-	1.423
Subscript f	-	3.000	2.000	2.000	2.000	40.000
Total	17.000	84.000	70.000	44.000	71.000	522.000

Table XI-D

Labor costs per "productive" man-hour

Grade	Cost per man-hour	Variable personnel by branch: MAP	Eng. and Gear	Docu. Anal. and Recs.	Item Description and Preservation: Re-search	Pack. and Pres.	Other	Elec-trical	Ma-chinery	Mech.	Fixed per-sonnel
Commander	$7.33	-	-	-	-	-	-	-	-	-	1
Lieutenant Commander	5.82	-	-	-	-	-	-	-	-	-	4
Chief Petty Officer	3.55	-	-	-	-	-	-	-	-	-	1
GS-14	8.07	-	-	-	-	-	-	-	-	-	1
GS-13	7.11	-	-	-	-	-	-	-	-	-	7
GS-12	6.09	-	2	3	2	1	2	4	2	4	3
GS-11	5.24	2	-	7	2	1	4	-	1	-	8
GS-10	4.66	-	5	-	10	3	4	12	10	13	-
GS- 9	4.32	20	22	63	10	5	38	39	25	44	1
GS- 8	3.99	-	-	1	-	-	-	-	-	-	-
GS- 7	3.66	2	1	5	6	2	4	4	-	2	1
GS- 5	3.05	-	1	15	1	-	3	3	2	3	3
GS- 4	2.72	2	-	8	1	2	5	-	-	-	7
GS- 3	2.55	-	3	9	7	3	7	1	2	3	2
GS- 2	2.39	-	2	17	3	-	7	1	-	-	1
GS- 1	2.20	-	-	1	-	-	-	-	-	-	-
Total no. of persons		26	36	129	42	17	74	64	42	69	40
Average cost per man-hour		$4.217	$4.157	$3.742	$3.934	$3.960	$3.891	$4.336	$4.362	$4.335	$4.896

Table XI-E

Annual labor costs corresponding to workloads by branch(1)

(in dollars)

Workload symbol	MAP	Engine and Gear	Document Anal. & Recs.	Research	Item Description and Preservation: Pack and Pres.	Item Description and Preservation: Other	Electrical	Machinery	Mechanical	Fixed Personnel	Total Tech. Div.
Variables											
C_h	-	19,706	-	-	14,419	126,332	53,343	25,328	88,537	-	327,665
D_h	-	-	294,645	-	-	-	-	-	-	-	294,645
E_h+F_h	-	-	-	-	24,220	-	-	-	-	-	24,220
$C_p+E_p+F_p$	-	-	-	-	6,896	108,331	-	-	-	-	115,227
G_h	-	35,910	37,578	12,684	30,732	49,785	133,687	84,178	142,493	-	527,047
G_p	-	-	-	-	27,236	39,676	-	-	-	-	66,912
M_h	-	66,336	136,607	37,028	13,277	139,863	61,100	37,612	78,906	-	570,729
M_p	-	-	-	-	1,637	23,277	-	-	-	-	24,914
Constants											
Subscript ah	-	76,178	87,477	21	-	1,095	261,760	165,586	207,308	-	799,425
Subscript nh	281,873	57,795	22,936	253,746	-	57,273	8,748	9,553	8,899	-	700,813
Subscript np	-	-	-	996	-	8,754	-	-	-	-	9,750
Subscript f	-	-	-	-	-	-	-	-	-	344,483	344,483
Total	281,873	255,925	579,233	304,475	118,417	554,386	518,638	322,257	526,143	344,483	3,805,830

(1) Data by branch exclude fixed personnel.

The total labor costs corresponding to workload variables in the Technical Division were then converted to costs per unit. For each workload variable, the estimated total annual labor cost, as shown in Table XI-E, was divided by the estimated current annual workload. The estimates used for current annual workloads were the values given for the workload variables in Section B.1 of this chapter. The results are shown in Table XI-F.

C. Cost Models

1. General

The cost models given in this chapter include only labor costs. The cost of printed forms, paper, etc., consumed in the Technical Division is not significant. No machine rental costs are incurred in the Technical Division.

2. Short-Run Costs

All labor costs are treated as fixed in the short run. The estimated total labor costs in the Technical Division at current annual rates, as shown in Table XI-F, amount to $3,805,830. Thus, the short-run model is:

$$T_s = 3,805,830_f$$

where

T_s = total short-run annual dollar costs treated in this chapter.

3. Long-Run Costs

The estimated long-run labor costs for the Technical Division are as developed in Section B of this chapter and summarized in Table XI-F. The cost equation is as follows:

$$T_l = 10.33C_h + 2.432D_h + 0.72(E_h + F_h) + 9.01(C_p + E_p + F_p)$$
$$+ 3.653G_h + 1.122G_p + 4.277M_h + 0.551M_p + 799,425_{ah}$$
$$+ 700,813_{nh} + 9,750_{np} + 344,483_f$$

where

T_l = total long-run annual dollar costs treated in this chapter and where the other symbols are as shown in the list given at the front of this volume.

Table XI-F

Annual labor costs in Technical Division

Workload symbol	Estimated current annual labor costs	Estimated current annual work-loads in line items	Labor cost per unit of workload
Variables			
C_h	$ 327,665	31,708	$ 10.334
D_h	294,645	121,142	2.432
$E_h + F_h$	24,220	33,592	0.721
$C_p + E_p + F_p$	115,227	12,792	9.008
G_h	527,047	144,278	3.653
G_p	66,912	59,631	1.122
M_h	570,729	133,443	4.277
M_p	24,914	45,257	0.551
Constants			
Subscript ah	799,425	-	-
Subscript nh	700,813	-	-
Subscript np	9,750	-	-
Subscript f	344,483	-	-
Total	$ 3,805,830		

D. Elapsed Times

1. General

In this section elapsed times in the Technical Division for H-cog replenishment recommendations are discussed. Elapsed times for requisitions are not discussed in this section since they were treated in the analysis of the Stock Control Division.

After R.R.'s are prepared by the Data Processing Division, copies are routed simultaneously to the Financial Control Division and to the Technical Division. Both copies are then routed to the Purchase Division where they are matched prior to procurement action. Time in the Financial Control Division is virtually always less than time in the Technical Division. Thus, the Technical Division is the significant predictor of this component of total administrative lead time for stock replenishments.

All R.R.'s are received in a Control Unit of the Item Description and Preservation Branch of the Technical Division. Certain of the R.R.'s are logged in, routed to equipment specialists in the Item Description and Preservation Branch (or in certain cases, to equipment specialists in the Material Determination Branches) for processing, returned to the Control Unit, and logged out. All R.R.'s are routed through the Preservation and Packaging Section before going to the Purchase Division.

The R.R.'s which are routed directly to the Preservation and Packaging Section require about 2 days to process. This estimate is based upon observations and interviews with personnel concerned. Since this workload is processed on a priority basis and comprises a small fraction of the total workload in the Preservation and Packaging Section, the elapsed times do not vary significantly with workload volume. Thus, these elapsed times are assumed to be constant.

Therefore, the average elapsed time for H-cog R.R.'s in the Technical Division may be expressed in the form:

$$t_1 = 2.0 + U_2 Y$$

where t_1 = average elapsed time in days for H-cog R.R.'s in the Technical Division.

U_2 = ratio of R.R.'s routed to equipment specialists to total R.R.'s produced.

Y = average elapsed time in days between the date that R. R. 's going to equipment specialists are logged in and the date that they are logged out.

According to counts supplied by the Control Unit, 46.4% of all R.R.'s received during fiscal year 1960 were routed to equipment specialists. Thus, the estimated average value for U_2 is 0.464. The time denoted by Y is large and is discussed in the remaining portions of this section.

2. Data Available

There are two principal sources of data on elapsed times for H-cog R.R.'s processed by equipment specialists. The first consists of the dates logged in and out, as recorded in the R.R. folders kept in the Control Unit of the Item Description and Preservation Branch. In order to obtain estimates of the elapsed times, a systematic sample of these R.R. folders was taken by Federal Stock Number. Only folders received during fiscal year 1960 were sampled. In July 1960 recording of the in and out dates was discontinued. Thus, more recent data were not available.

A total of 840 line items on R.R.'s was sampled. This represents about 6% of the H-cog R.R.'s processed by equipment specialists during fiscal year 1960. For each R.R. line item sampled, the date received by the Control Unit and the date released by the Control Unit were recorded. Then the difference (i.e., the elapsed time) in days was computed. The average elapsed time was 17.0 days.

The second major source of data consists of counts on receipts, releases, and work-in-process for H-cog R.R.'s processed by equipment specialists. These counts are kept by the Control Unit of the Item Description and Preservation Branch. The data are available beginning April 1960. (Some data are available for periods prior to April 1960, but are considered unreliable.)

Figure XI-A shows these data plotted on a weekly basis for the period April 2, 1960, through February 11, 1961. The upper line shows work-in-process on April 2, 1960, plus receipts since that date on a cumulative basis. The lower line shows cumulative releases since April 2, 1960. The vertical distance between the two lines represents work-in-process at any point in time. The horizontal distance between the two lines provides an estimate of average elapsed time for the R.R.'s. If it is assumed that the R.R.'s are processed on a first-in and first-out basis, the elapsed time for R.R.'s received in any

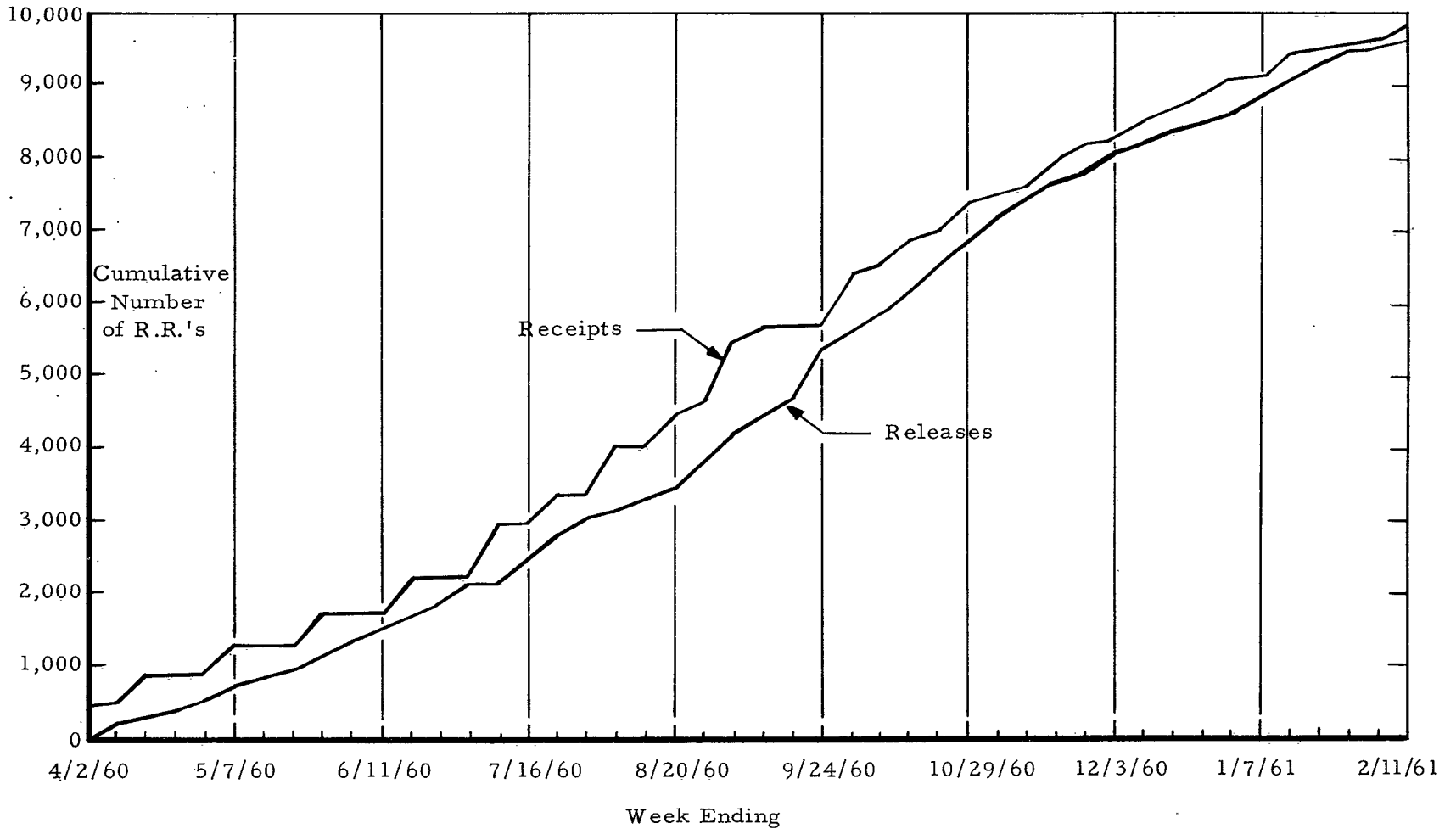

Figure XI-A. H-cog R.R.'s processed by equipment specialists - Cumulative receipts and cumulative releases by control unit.

period may be computed. Although this assumption is somewhat unrealistic for individual R.R.'s, it does give reasonably accurate estimates of the average elapsed time for R.R.'s received during a period such as a week. Since actual elapsed times are not available for periods since June 1960, this method of estimating average elapsed times is used in this analysis.

Figure XI-A illustrates some of the effects of procedural changes that have been made during the last year. Prior to July 1960, supply-demand reviews were made every 3 weeks. Thus, large numbers of R.R.'s were received every third week, with relatively small numbers received in the intervening weeks. Beginning in July 1960, supply-demand reviews were made every 2 weeks and large numbers of R.R.'s were received every second week. A more significant change was made about 3 months later, when the supply-demand review procedure was changed to cover the fast and slow moving fractions of items on alternate weeks. As a result the number of R.R.'s received for processing by equipment specialists became more nearly constant each week. Elapsed times changed correspondingly. Prior to October 1960, elapsed times averaged about 2-1/2 weeks. Since October the average has been 11 days. This illustrates the fact that procedural changes do have important effects upon elapsed times. Average elapsed times prior to October 1960 are of little use in predicting elapsed times with present operating procedures.

Figure XI-A also illustrates some of the effects of workloads upon elapsed times. In July 1960 the number of receipts suddenly increased. The number of releases increased correspondingly. (This was accomplished without a change in man-hours expended.) However, the increase in releases occurred somewhat after the increase in receipts. As a result, average elapsed times increased for a while and then declined to their former levels. This suggests that the elapsed times are not affected by the level of workload over the range for which data are available, but that sudden changes in workload have temporary effects on the elapsed times. One possible explanation, which will be elaborated upon later, is that an attempt is made to hold elapsed times constant. Sudden increases in workload cause unanticipated increases in work-in-process which result in temporary changes in elapsed times.

3. Analysis of Data

In order to estimate the effects of workload volumes upon elapsed times with present operating procedures, the data for the period, October 1, 1960, through February 11, 1961, were analyzed in detail. Figure XI-B shows estimated average elapsed time plotted against the number of R.R.'s received on a weekly basis. The data indicate that elapsed times are not correlated with workload input (which is defined to exclude work-in-process) over

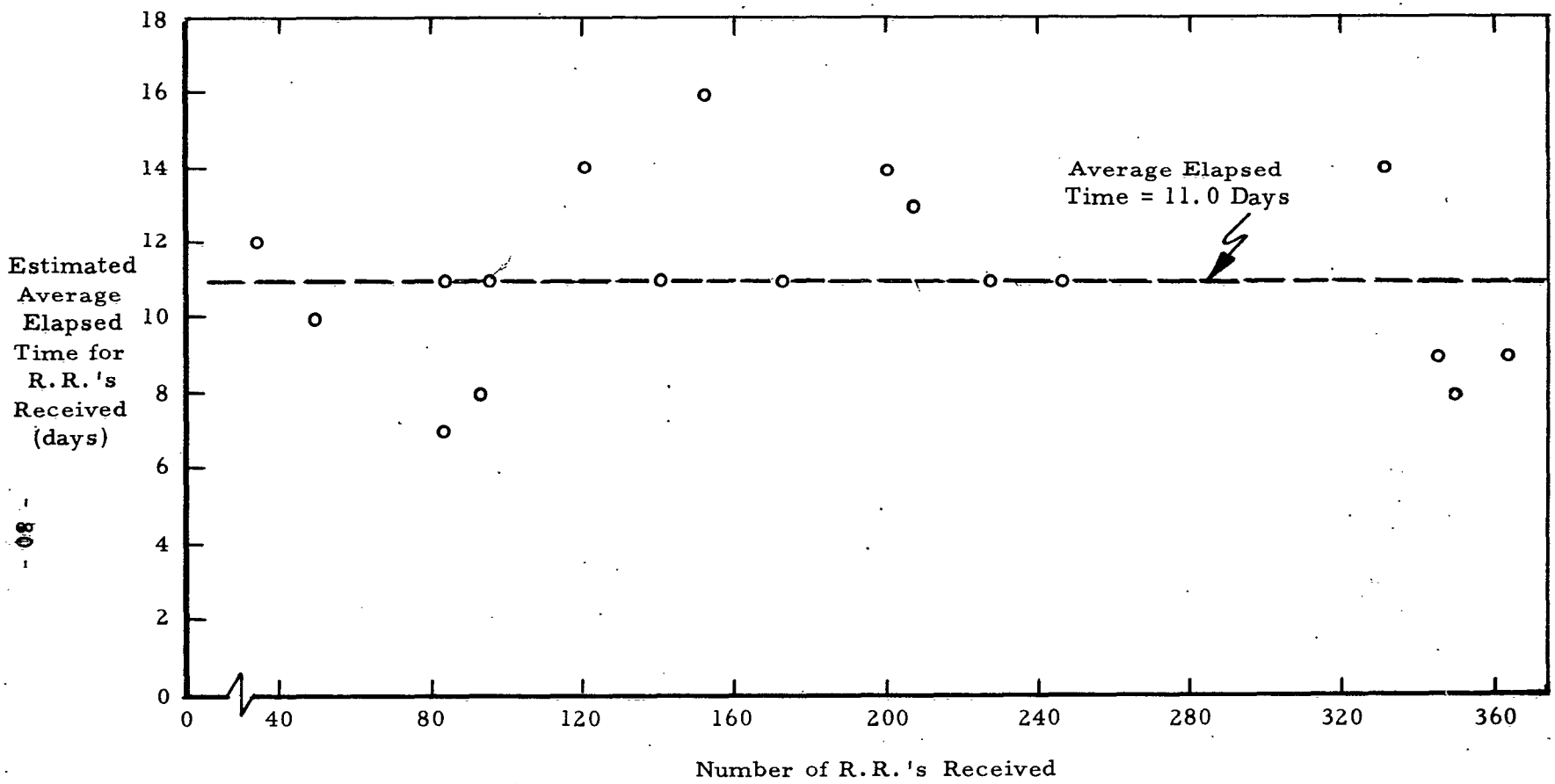

Figure XI-B. H-cog R.R.'s processed by equipment specialists - Number received vs. average elapsed time, by weeks.

the range of workload volumes for which data are available. Of course, elapsed times may increase at higher levels of workload input. However, there is no empirical evidence to support such a contention, and it is doubtful that the phenomenon would actually occur. Rather, it appears more likely that if workload volumes were to increase enough to affect elapsed times, either procedural changes would be made or staffing would be increased enough to bring elapsed times back to their normal levels.

It might be suggested that the lack of correlation between workload input levels and elapsed times is caused by variations in work-in-process (which is defined to include backlog). Of course, if variations in work-in-process were very large, it would be possible for them to hide the effects of workload input upon elapsed times. In a system operating at close to capacity with large amounts of work-in-process, the average elapsed time for the workload input would be almost directly proportional to the sum of the workload input and the work-in-process.

In order to check on this possibility, Figure XI-B was redrawn so as to include work-in-process in the measure of workload input. The results are shown in Figure XI-C. Even when the effects of work-in-process are included, there is no significant correlation between workload and elapsed times. This suggests that output varies with the amount of work received and the amount of work-in-process. Figure XI-D shows that weekly output is almost directly proportional to weekly input plus work-in-process. Thus, it appears that output varies as a function of the amount of work available, but that elapsed times do not depend upon the amount of work available.

Several reasons for the above phenomenon can be proposed. One possibility is that, when the number of R.R.'s to be processed increases, personnel are shifted from other work, such as processing P-cog R.R.'s or determining allowance and load list requirements. However, analysis of work measurement data indicates that this is not the case. Man-hours associated with processing H-cog R.R.'s do not vary with the number of R.R.'s processed.

A second possibility is that, when workloads increase, personnel work longer hours. For example, they may reduce the duration of their coffee breaks or work overtime without pay, as happens in the Purchase Division. However, observations and discussions with personnel involved indicate that this does not occur in the Technical Division.

Another possible explanation is that processing R.R.'s takes priority over other work of the equipment specialists. When the number of R.R.'s to

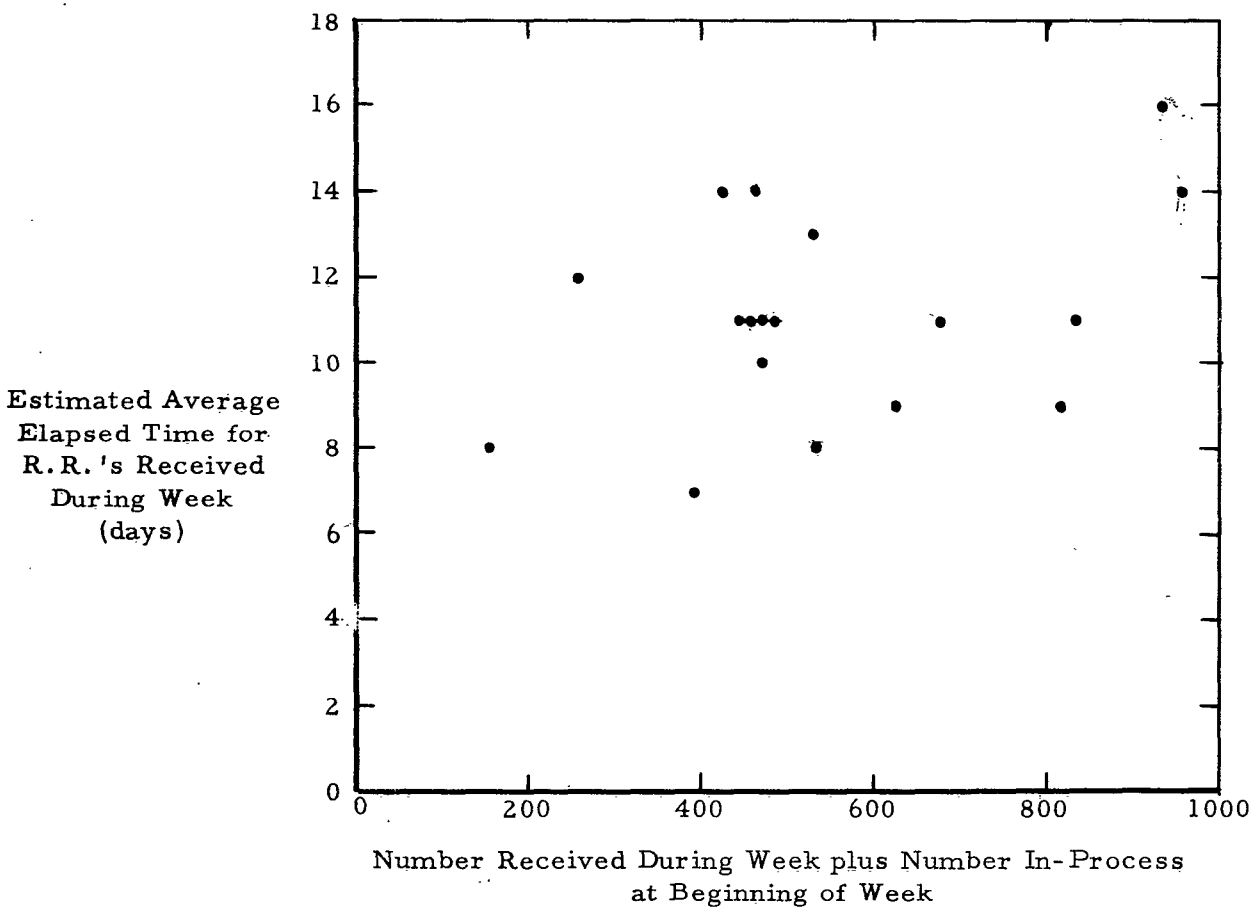

Figure XI-C. H-cog R.R.'s processed by equipment specialists - Number received and in-process vs. average elapsed time, by weeks.

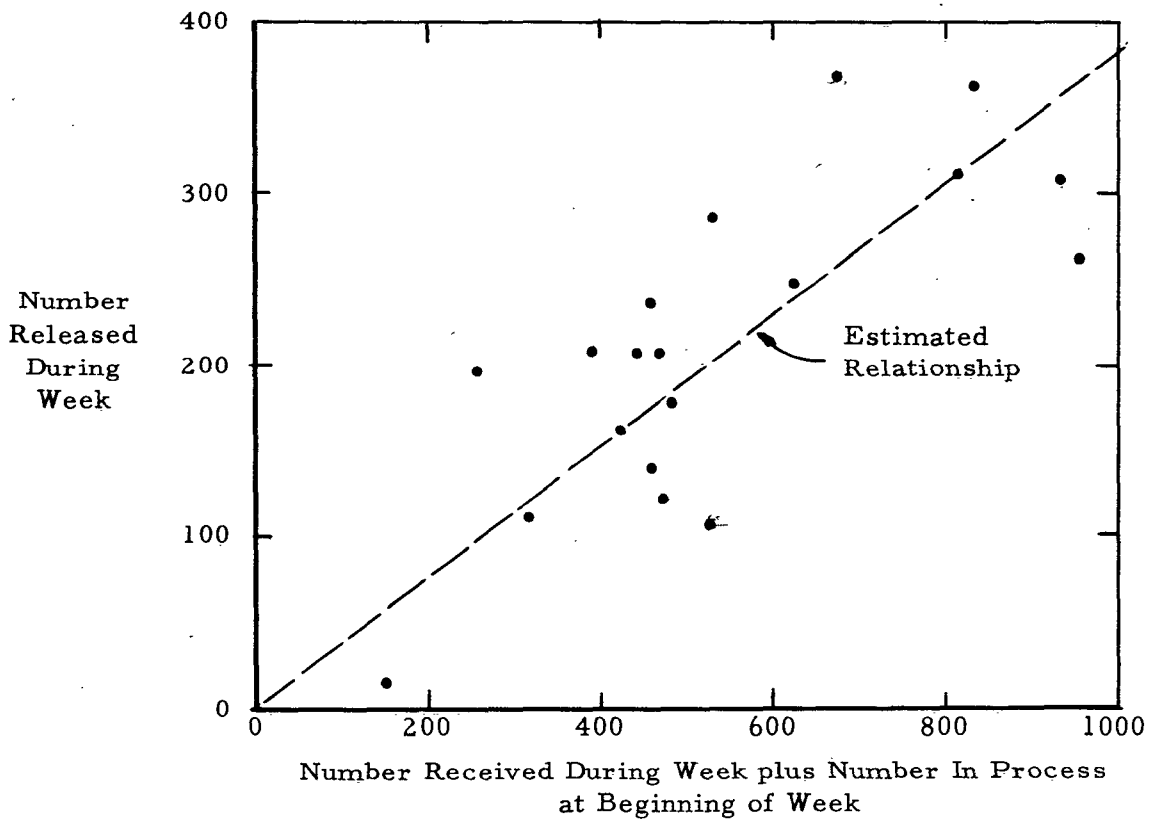

Figure XI-D. H-cog R.R.'s processed by equipment specialists - Number received and in process vs. number released - by weeks.

be processed increases other technical work is deferred temporarily. Although this explanation may have some validity, it cannot account for the failure of elapsed times to increase with the major changes in workload levels that were observed.

The principal reason that elapsed times do not vary with the levels of workload observed is believed to be the following. The bulk of the workload arrives in a batch once a week. (As has been pointed out, prior to October 1960, it was biweekly, and prior to July 1960, it was triweekly.) The incoming documents are handled in such a way that the equipment specialists always have a rough idea of the amount of work to be performed (i.e., of the amount of work-in-process, including backlog). Also, they know when the next batch is expected. If the amount of work to be performed is large compared with the number of days before the next batch is due, there is a tendency to increase output. Conversely, there is a tendency to reduce output if the amount of work to be performed is relatively small. The variation in the rate of output with changes in work-in-process is such that there is always some work-in-process and such that <u>average</u> elapsed times remain reasonably constant.

This variation in output appears to be achieved through changes in the pace at which people work and through changes in the quality of performance. However, the effect on quality of performance, as measured by elapsed times, error rates, etc., is not detectable. This is because a sort of quality plateau has been attained. For example, an equipment specialist may check a certain identification number in one file or in three files, depending upon the demands for his time (i.e., the workload available). In either case, an error is so unlikely that there will be no measurable effect upon the quality of his work.

The foregoing suggests that some reduction in staffing might be accomplished without affecting elapsed times or other measures of the quality of performance, unless the workload were to increase to levels higher than those observed. The situation may be similar to that which existed in the Document Analysis and Records Branch of the Technical Division in early 1960. As has been previously explained, during calendar year 1960 a 31% reduction in staffing in this branch was accomplished without any detectable effect on either volume or quality of output. [1]

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[1] Section B.2.a of this Chapter.

4. Variation in Elapsed Times

Since almost half of all H-cog R. R. 's are processed by equipment specialists, and since this involves a relatively large amount of time, information on the variation in elapsed times of R. R. 's processed by equipment specialists is desirable. Unfortunately, such data are not available, since recording of in and out dates was discontinued in July 1960. The distribution of elapsed times for fiscal year 1960 was estimated from the sample of 840 line items on R. R. 's which was taken. However, the variance information thereby obtained is not pertinent to current operations, since procedural changes have reduced the average elapsed time from 17.0 days to 11.0 days.

It is felt that reasonably accurate estimates of variation in elapsed times can be made by assuming that the procedural changes shifted all points on the distribution of elapsed times by the same percentage. It follows from the above assumption that the standard deviation of elapsed times was changed in direct proportion to the change in mean. Since the standard deviation of the old distribution of elapsed times was estimated to be 13.2 days, the present standard deviation is estimated to be 8.5 days.

Although the above assumption appears to be reasonable, it cannot be verified. However, a crude check was made. This involved segregating the R. R. 's sampled according to month received and plotting the estimated standard deviations of elapsed time against the estimated means for each month. The results are shown in Figure XI-E. The standard deviations appear to be approximately proportional to the means. It seems reasonable to expect the same sort of relationship when considering annual, rather than monthly, distributions, though, of course, the ratio of the standard deviations to the means might be higher.

Figure XI-F shows the estimated cumulative frequency distribution of elapsed times with present procedures. It will be noted that the distribution is badly skewed, with the tail above the mean being very long and with the tail below the mean being truncated. The estimated central values of the distribution are:

Mean:	11 days
Median:	9 days
Mode:	6 days

5. Model

The estimated average elapsed time in the Technical Division for H-cog R. R. 's is:

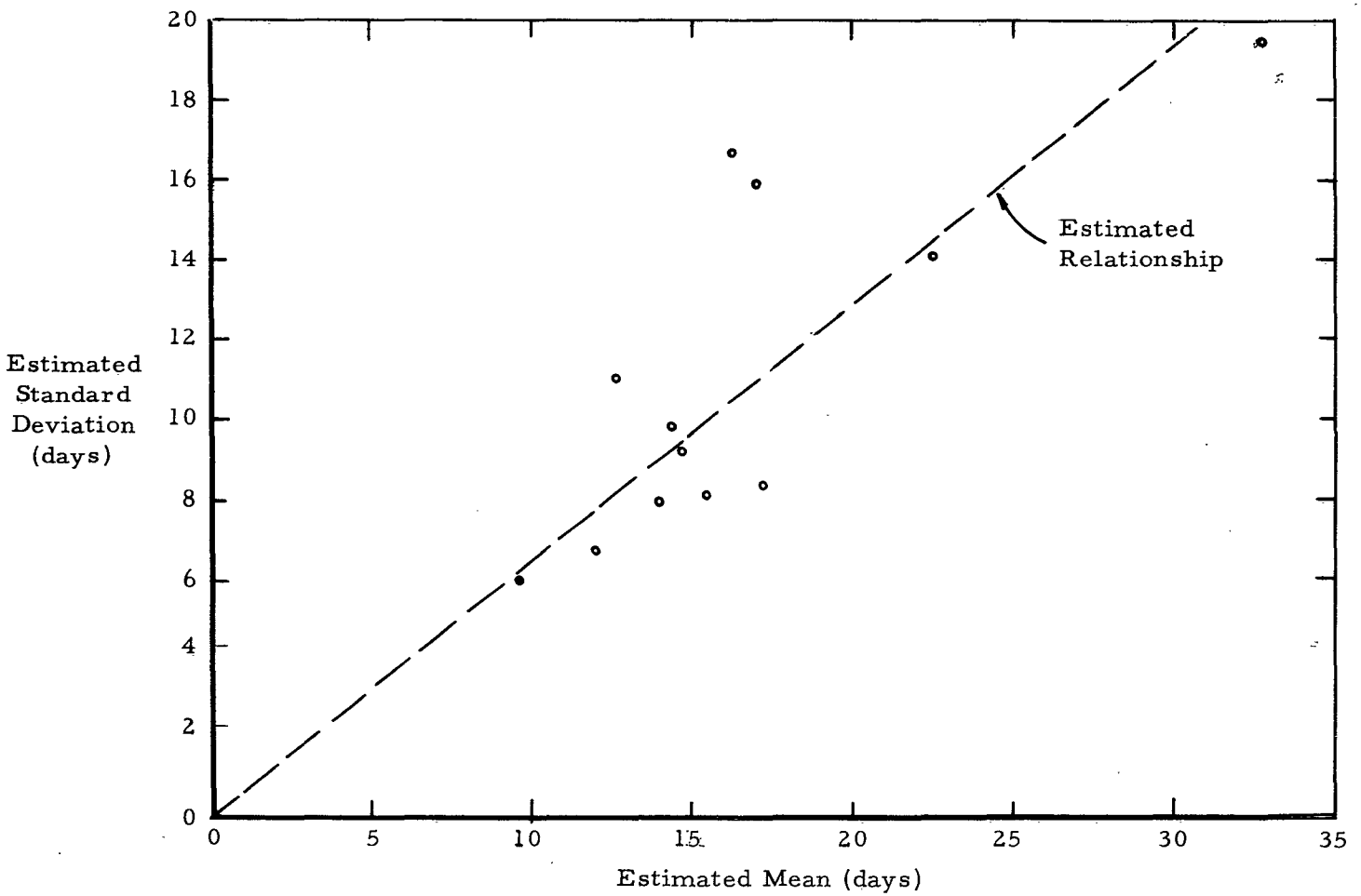

Figure XI-E. Elapsed time for H-log R.R.'s processed by equipment specialists - Estimated standard deviations vs. estimated means, by month.

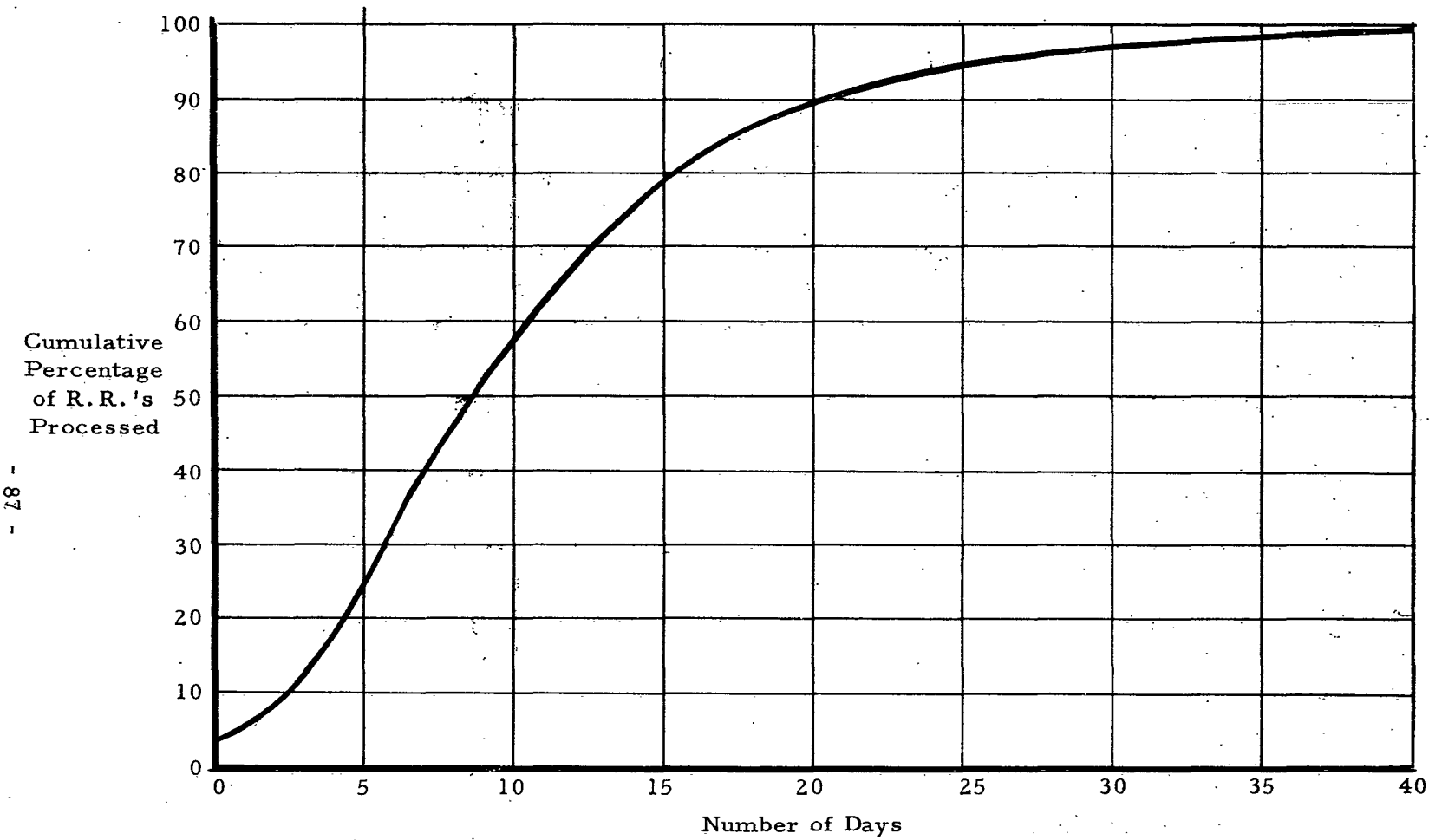

Figure XI-E. H-cog R.R.'s processed by equipment specialists - Estimated cumulative frequency distribution of elapsed times.

$$t_1 = 2.0 + 11.0 U_2$$

where t_1 = average elapsed time in days for R. R. 's in the Technical Division

U_2 = ratio of R. R. 's routed to equipment specialists to total R. R. 's produced.

The variable U_2 may take on any value between zero and one. The average value of U_2 observed during the study was 0.464.

The foregoing model for average elapsed time in the Technical Division for H-cog R. R. 's does not contain any terms representing workload volume. The reason for this is that elapsed times do not vary with workload levels under the conditions observed during this study. However, this situation could change in the future as a result of such factors as a reduction in staffing levels, a major increase in workload levels, or a change in processing procedures. Such changes could result in elapsed times being highly sensitive to variations in workload levels. Under these circumstances a new, and probably more complex, function would be required to predict average elapsed times.

XII. FINANCIAL CONTROL DIVISION

A. Description

1. General

The Financial Control Division has a staff of 24 people. Its major functions are budgeting and financial planning for control of system inventories, transaction accounting and reconciliation of procurements for replenishment of system stocks, and furnishing and maintaining price information on system stock items. The latter two functions are performed for Subarpso as well as for SPCC. Budgeting and financial planning for P-cog items are carried on by Subarpso. Transaction accounting is not performed on purchase requisitions except those covering stock items which are procured from Naval Stock Fund resources.

The division has three branches: Material Budget and Investment, Stock Finance, and Stock Pricing. The activities of each branch and the work flows are discussed below. The immediate support staff of the division director is composed of a civilian assistant and a secretary.

2. Material Budget and Investment Branch

This branch consists of three people. It is responsible for budgeting and financial planning. The workload of this branch is basically independent of the decision alternatives of interest in this report. This branch does not perform work for Subarpso.

3. Stock Pricing Branch

The Stock Pricing Branch is composed of seven people. It is responsible for establishing, reviewing and revising standard unit prices for H-cog and P-cog stock items. These prices include purchase prices, first destination transportation charges, packaging and preservation charges, and allowances for losses. These are the prices charged to the fleet for stock items issued. The branch also furnishes prices to the Purchase Division as a guide for procurement actions.

4. Stock Finance Branch

The Stock Finance Branch has 11 people. Three are in a Reconciliation Section, which is responsible for reconciling SPCC and Subarpso records with records of Naval Regional Accounts Offices, Bushipe, and Busanda. Five

people are in a Records and Reports Section, which is responsible for maintaining accounting records on commitments and obligations of SPCC's and Subarpso's Naval Stock Funds, for editing accounting information on procurement documents, and for preparing various financial reports. The remaining three people are at the branch level. They summarize fiscal data for use by management, prepare reports for higher authority, and render assistance in accounting matters relative to procurement and the availability of funds.

5. Work Flow

Copies of the R.R.'s arrive from Stock Control and are posted to a commitment ledger in the Stock Finance Branch. The Stock Pricing Branch then puts the last price obtained on the R.R. and forwards the R.R. to the Purchase Division. When a contract has been let, a copy is forwarded to Financial Control. The Stock Finance Branch posts the amount of the contract to the obligation ledger. The Stock Pricing Branch will also post the new price to their records. The contract remains in an open file. Finally invoices, contracts and public vouchers showing payment by an NRAO will be reconciled and the files closed. The Stock Pricing Branch also establishes standard prices on new provisioning items.

NSI purchase requisitions are not posted by Financial Control. NIS purchase requisitions (purchased with NSF dollars) are treated like R.R.'s except prices are not posted. A detailed diagram of the work flows within the Financial Control Division is presented in Appendix I.

B. Labor Costs

1. Man-Hours

In this analysis of labor costs, the Financial Control Division is broken down into four component organizational units, consisting of: 1) the division director and his immediate support staff, 2) the Material Budget and Investment Branch, 3) the Stock Pricing Branch, and 4) the Stock Finance Branch. The work performed within each of these units is relatively homogeneous.

Data collected by SPCC are not broken down in the above manner. The Financial Control Division charges "productive" time to three functions: Standard Pricing, Project Accounting, and Management and Planning. These functions do not correspond precisely to the organizational units described above. Estimates of "productive" man-hours broken down by these units are shown in Table XII-A.

Table XII-A

"Productive" man-hours, fiscal year 1960

Organizational unit	"Productive" man-hours
Director and support staff	5,277(1)
Material Budget and Investment Branch	5,277(1)
Stock Finance Branch	19,349(2)
Stock Pricing Branch	14,498(3)

(1) Assumes three people each working 1,759 "productive" man-hours (see Chapter VIII, Section B, of this volume).

(2) Man-months charged by the Financial Control Division to the Project Accounting function, as obtained from work sheets of the Budget and Statistics Branch of the Administrative and Management Planning Division, times the number of "productive" man-hours in each month, less the man-hours assumed for the Material Budget and Investment Branch.

(3) Man-months charged by the Financial Control Division to the Standard Pricing function, as obtained from the Budget and Statistics Branch of the Administrative and Management Planning Division, times the number of "productive" man-hours in each month.

2. Labor Costs per Man-Hour

Since each of the organizational units described above performs different types of work, significant differences in the average labor cost per man-hour in each of the units might be expected. Therefore, the average labor cost per "productive" man-hour was calculated for each one. These calculations are shown in Table XII-B.

The first column of the table shows the grades of the employees. The second column shows the estimated current average labor cost per "productive" man-hour for each grade. Allowances for "nonproductive" labor and fringe benefits are included in the labor costs. The figures were taken from Chapter VIII, Section B, of this volume. The remaining columns show the staffing in each organizational unit. The last row of the table shows the average labor cost per "productive" man-hour in each unit. This is simply an average of the costs per man-hour shown for each grade, weighted by the staffing for each organizational unit. A small change in staffing will, of course, have little effect on the weighted averages.

3. Man-Hours Associated with Workloads

a. General

For each organizational unit the workloads performed were identified and the "productive" man-hours associated with each of these workloads were estimated. The analysis for each of the organizational units is described below:

b. Division Director and Support Staff

The division director and his immediate support staff were considered to be independent of changes in workload over the range of workloads being considered. Thus, the costs of these personnel were treated as fixed and were denoted by the subscript, f.

c. Material Budget and Investment Branch

The workload of this branch is independent of the decision alternatives of interest in this report. The branch does not provide services to ubarpso. Thus, the costs of personnel in this branch were treated as constant and were denoted by the subscripts, nh.

Table XII-B

Labor costs per "productive" man-hour

Grade	Cost per man-hour	Staffing[1] Division director's staff	Material Budget & Investment Branch	Stock Finance Branch	Stock Pricing Branch
Lieutenant Commander	$5.82	1			
GS-12	6.09	1			
GS-11	5.24		1		
GS- 9	4.32		1		
GS- 7	3.66			1	1
GS- 5	3.05	1	1	3	1
GS- 4	2.72			4	6
GS- 3	2.55			3	
Total personnel		3	3	11	8
Average cost per man-hour		$4.99	$4.20	$2.85	$2.88

(1) Based on SPCC Manpower Listing, SECNAVINST 5320.4, 31 March 1960

d. Stock Finance Branch

The Stock Finance Branch processes all purchases of H-cog and P-cog items that are on the Navy Stock List. R.R.'s and NIS purchase requisitions are routed through this branch for posting to the commitment ledger. After procurement actions are taken on items covered by Naval Stock Funds, copies of the purchase orders or contracts are sent to this branch for posting out of the commitment ledger and into the obligation ledger. The purchase orders or contracts are then held in an open file until they are reconciled with invoices received from contractors and public vouchers received from Naval Regional Accounts Offices. Thus, the workload of this branch is dependent upon the number of R.R.'s and NIS purchase requisitions processed. The workload is denoted by the symbols, C_h, C_p, E_h, and E_p.

Productivity in the Stock Finance Branch was examined on a monthly basis for fiscal year 1960. The measures of workload used were taken from internal work measurement reports of the Financial Control Division, as well as from other counts supplied by the Purchase Division. Since the level of activity in this division appeared to be at a fairly high rate it was assumed that management would act, if workloads were to change significantly in the long run, so as to preserve this quality of performance. Thus the observed average productivity was employed as a measure of the productive capability, in the Financial Control Division.

During fiscal year 1960, 52,834 line items on R.R.'s and NIS purchase requisitions for H-cog and P-cog materials were processed.[1] During the same period, the Stock Finance Branch incurred 19,349 man-hours.[2] Thus, it is estimated that in the long run there will be 0.366 "productive" man-hour per line item.

e. Stock Pricing Branch

The Stock Pricing Branch furnishes historical price information on all H-cog and P-cog R.R.'s for the Purchase Division to use as guides

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1 Purchase Division, Work Measurement Reports, Fiscal Year 1960.

2 See Table XII-A

in placing purchase orders and contracts. The branch also reviews the price on priced purchase orders and contracts which are placed as a result of H-cog and P-cog R.R.'s. Purchase requisitions are not processed in this branch.

Part of the workload of this branch is dependent upon the total number of R.R.'s processed, and part of the workload is dependent upon the number of price reviews required. (The number of R.R.'s processed is somewhat larger than the number of price reviews made, when both are measured in line items, because prices on R.R.'s which result in unpriced purchase orders are not reviewed.) During fiscal year 1960 the branch furnished prices on 40,380 line items.[1] If this is used as a measure of workload for the branch, the average number of man-hours per line item reviewed for price is 14,498 man-hours divided by 40,380 line items or 0.359.[2]

During fiscal year 1960, 43,372 line items on R.R.'s were handled.[3] If this is used as the measure of workload for the branch, the average number of man-hours per line item is 14,498/43,372, or 0.334.

Since the number of price reviews made is not used as a variable elsewhere in this report, and since it is dependent upon and almost equal to the total number of R.R.'s processed, the latter is used as the measure of workload in this analysis. This is the equivalent of assuming a constant ratio of R.R.'s to price reviews. Thus, the estimate of 0.334 man-hour per line item is used in this analysis to predict future long-run labor costs in the Stock Pricing Branch.

4. Labor Costs Associated with Workloads

The labor costs associated with each of the workloads is simply the product of the man-hours associated with the workload shown in Sections B.1 and B.3 of this chapter and the labor costs per man-hour shown in Table XII-B. This is shown for each organizational unit in Table XII-C.

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1 Number of stock items reviewed for pricing action as reported in monthly SPCC Supply Management Reports, Part I, page 1, line 7, Fiscal Year 1960.

2 Man-months contributed by the Financial Control Division to the Standard Pricing function, as obtained from work sheets of the Budget and Statistics Branch of the Administrative and Management Planning Division, times the number of "productive" man-hours in each month.

3 Purchase Division, Work Measurement Reports, Fiscal Year 1960.

C. Cost Models

1. General

The cost models in this chapter include only labor costs. The costs of printed forms, paper, etc., consumed in the Financial Control Division are not significant. No machine rental costs are incurred in this division.

2. Short-Run Costs

All labor costs are treated as fixed in the short run. The estimated total labor cost in the Financial Control Division at current annual rates is the unit labor cost, as shown in Table XII-C, times the number of units processed, as given in Section B.3 of this chapter. This is shown in Table XII-D.

Table XII-C

Workloads and labor costs

	Organizational Unit			
	Division director and staff	Material Budget and Investment Branch	Stock Finance Branch	Stock Pricing Branch
Workloads				
Variables			$C_h+C_p+E_h+E_p$	C_h+C_p
Constants	Subscript f	Subscript nh		
Man-hours				
Per unit of workload			.366	0.334
Per year	5,277	5,277		
Average cost per man-hour	$4.99	$4.20	$2.85	$2.88
Labor cost				
Per unit of workload			$1.043	.962
Per year	$26,332	$22,163		

Table XII-D

Total labor costs

Workloads	Units processed in fiscal 1960	Unit labor cost	Total labor cost
Constants			
Subscript f	-	-	$26,332
Subscript nh	-	-	22,163
Variables			
$C_h+C_p+E_h+E_p$	52,834	$1.043	55,105
$C_h + C_p$	43,372	0.962	41,724
Total			$145,324

Thus, the short-run cost model is:

$$T_s = 145,324_f$$

where T_s = total short-run annual dollar costs treated in this chapter.

3. Long-Run Costs

The estimated long-run labor costs for the Financial Control Division are as developed in Section B of this chapter and summarized in Table XII-D. The complete cost equation is:

$$T_l = 1.043 (C_h + C_p + E_h + E_p) + 0.962 (C_h + C_p) + 22,163_{nh} + 26,332_f$$

or

$$T_l = 2.01 (C_h + C_p) + 1.04 (E_h + E_p) + 22,163_{nh} + 26,332_f$$

where T_1 = total long-run annual dollar costs treated in this chapter and where the other symbols are as shown in the list given at the front of this volume.

D. Elapsed Times

Under the present procedure, the commitment of funds and the furnishing of price information on R.R.'s are done by the Financial Control Division simultaneously as other copies of the R.R.'s are processed by the Technical Division. Only the longer of the elapsed times affects total elapsed times in SPCC. Discussions with supervisors and observations of procedures indicate that present elapsed times through the Financial Control Division average less than four hours, and that only on rare occasions of extremely heavy short-term workloads do they exceed 1 day. In comparison with elapsed times in the Technical Division, the elapsed times for processing in the Financial Control Division are insignificant. Therefore, they will not be included in the elapsed time models.

Reconciliation of invoices and public vouchers is accomplished after purchases have been made and invoices have been paid. This is of little consequence in terms of elapsed time in the system and, therefore, is not treated explicitly in this report.

XIII PURCHASE DIVISION

A. Description

1. General

The Purchase Division employs about 150 people. Its major function is to accomplish the procurement of H-cog and P-cog items. It is responsible for procurement negotiations, preparation and placement of orders, maintenance of contract files, and administration of procurement contracts. The division makes procurement of both H-cog and P-cog materials to fill requisitions for not-in-stock and non-stocked items, to replenish system stocks, and to fill provisioning requirements.

The division has three branches: Buying, Purchase Services, and Contractor Performance. Personnel within each branch are divided into sections and units. In addition, the director of the division and the directors of each of the branches have small staffs.

In this analysis the Purchase Division is divided into component organizational units. Each unit is analyzed separately. The organizational units used do not correspond precisely to the present organizational structure of the Purchase Division. They were selected so as to represent units which perform relatively homogeneous work. The functions of each of the organizational units, as classified in this analysis, are described below.

2. Directors and Their Staffs

The divisional director and his immediate support staff, and the three branch directors and their immediate support staffs are included in this organizational unit. These personnel are responsible for and/or provide services for the entire division or branch. Since the duties of the division and branch directors and their staffs are largely independent of the amount of work performed by the division, the costs of these personnel will be treated as fixed. Other personnel in the division (i.e., personnel assigned to specific sections and units) will, for the most part, be treated as variable.

3. Control

This organizational unit consists of the Control Unit, which is a part of the Records and Control Section of the Purchase Services Branch. It receives all incoming Purchase Division correspondence and dispatches and routes them to the appropriate sections. Requisitions for small purchases, which do not require action by the Buying Branch, are routed directly to the Document Production Section where unpriced purchase orders are prepared. Other requisitions and R.R.'s are routed to the appropriate sections of the Buying Branch. When the Buying Branch has determined the type and method of procurement, the purchase documents are routed back to the Control Unit and then forwarded to the Document Production Section. Copies of all completed purchase orders and contracts are also routed to the Control Unit.

The Control Unit maintains control records and prepares statistical reports on procurement activities. In addition, it reviews accounting information contained on requisitions, initiates commitment authorization requests for the purchase of material financed from the Navy Stock Fund, and transmits copies of all purchase documents to the appropriate paying offices.

4. Buying

This organizational unit includes all people in the Buying Sections except those clerks who work on contract modifications. These people review purchase requests, review the qualifications of suppliers, conduct negotiations with prospective suppliers, analyze bids and quotations, and determine types and methods of procurement. Requisitions for non-stocked items, which usually are satisfied through the preparation of purchase orders, normally are handled by the Priority Purchase Section. Other requisitions and R.R.'s for P-cog material are handled by the Submarine and Reactor Parts Section. The Internal Combustion Engine, Electrical, Standard Items, and Mechanical Sections handle other requisitions and R.R.'s for H-cog items. Purchase action may be taken through the preparation of a formal advertised contract, a formal negotiated contract, a priced purchase order, or an unpriced purchase order. The procedures used for processing items depend upon the type of contracts or purchase orders selected.

5. Document Production

This organizational unit consists of the Document Production Section, which is a part of the Purchase Service Branch. It consists of a Drafting and Proof-reading Unit, a Typing Unit, and an Assembly and Distribution Unit. The section is responsible for the preparation and distribution of advertised and negotiated contracts, priced and unpriced purchase orders, invitations for bids, shipping instructions, requests for quotations, etc., in accordance with established procedures and with instructions received from the Buying Branch.

6. Records

The Records Unit, which is part of the Records and Control Section of the Purchase Services Branch, comprises this organizational unit. The unit receives, records and abstracts bids for advertised contracts, issues printed military specifications, maintains bidders' lists and other records regarding advertised and negotiated contracts, and prepares budget estimates and maintains inventory control of forms and consumable supplies used in the Purchase Division.

7. Contract Files

This organizational unit consists of the Contract Files Unit, which is part of the Records and Control Section of the Purchase Services Branch. It maintains the contract and purchase order file folders for procurements.

8. Contractor Performance

This organizational unit includes all people assigned to sections in the Contractor Performance Branch and includes the clerks in the Buying Sections who work on contract modifications. The Immediate Issue Section monitors files, initiates follow-ups, answers inquiries, and prepares modifications on purchase orders to satisfy requisitions. It also reviews, approves and processes supplier's invoices submitted on unpriced purchase orders. The Stock Replenishment Section reviews the contract status record (which gives information on all purchase orders and contracts to replenish system stocks and is prepared by the Data Processing Division), expedites deliveries, and furnishes delivery status information to the Stock Control Division on procurements for system stocks. It also investigates delinquencies, initiates follow-up action, and notifies the Buying Branch of repeated poor contractor performance on such procurements. Modifications on contracts and purchase orders to replenishment systems stocks are handled by the clerks in the

Buying Sections. The Administration Section receives and distributes correspondence, performs typing, maintains records, and provides other clerical services to the Contractor Performance Branch.

9. Work Flows

The principal work inputs of the Purchase Division are R.R.'s and purchase requisitions. All such documents are first routed to the Control Unit in the Records and Control Section of the Purchase Services Branch, where they are logged in and certain other clerical operations are performed. They are then sent to the Typing Unit of the Document Production Section, which types in the names of potential manufacturers. The documents are then sent to the appropriate sections of the Buying Branch, which negotiate with prospective suppliers and prepare the purchase documents, returned to the Control Unit, and then sent to the Drafting and Proofreading Unit of the Document Production Section. Certain requisitions for small purchases are sent directly to the Drafting and Proofreading Unit without going to the Buying Branch. Purchase documents are then drafted, typed, and then forwarded to NSD Mechanicsburg's Reproduction Department, where they are reproduced and collated. The documents are then sent to the Assembly and Distribution Unit of the Document Production Section, where they are assembled and mailed.

A detailed diagram of work flows in the Purchase Division is included in Appendix I.

B. Labor Costs

1. Man-Hours

In this analysis, the Purchase Division is analyzed according to the component organizational units described above. This particular classification of organizational units is used because each of the units, as thus defined, performs more or less homogeneous work. Unfortunately, the man-hour data collected from the Purchase Division for inclusion in official SPCC reports are not broken down according to these organizational units. Moreover, the data are not reported in a manner which facilitates relating them to these organizational units or to the measures of workload used in this analysis.

The Purchase Division collected man-hour data until April 1960 which were reported in a more useful manner. These data were unofficial and were for the internal use of the Purchase Division. However, they are the source of most of the man-hour data used in this analysis.

Table XIII-A shows statistics on "productive" man-hours spent in each of the organizational units. The periods covered by these statistics differ, as noted in the table. The footnotes to the table describe how the data were obtained.

2. Labor Costs Per Man-Hour

Since each of the organizational units described above performs different types of work, significant differences in the average labor costs per man-hour in each of the units might be expected. Therefore, the average labor cost per "productive" man-hour was calculated for each organizational unit. These calculations are shown in Table XIII-B.

The first column of the table shows the ranks and grades of the employees. The second column shows the estimated current average labor cost per "productive" man-hour for each rank or grade. Allowance for "nonproductive" labor and fringe benefits are included in the labor costs. The figures were taken from Chapter VIII, Section B, of this report. The remaining columns show the assumed manning in each organizational unit, based on the official SPCC manpower listings as of 31 March 1960 adjusted for the particular subdivision of organizational units used in this analysis. The last row of the table shows the average labor cost per "productive" man-hour in each unit. This is simply an average of the costs per man-hour shown for each grade, weighted by the assumed manning for each unit.[1]

[1] These manning figures were not used as a basis for other estimates given in this chapter.

Table XIII-A

"Productive" man-hours[1]

Organizational unit	Period included	Man-hours
Directors and their staffs	7/59 - 6/60	28,144[2]
Control	7/59 - 6/60	15,831[3]
Buying	7/59 - 3/60	56,555[4]
Document Production	7/59 - 3/60	54,742[5]
Records	8/59 - 3/60	9,950[6]
Contract Files	8/59 - 3/60	8,706[6]
Contractor Performance	7/59 - 3/60	41,885[7]

[1]Source: Monthly Purchase Division Work Measurement Reports, Fiscal year 1960, with the exceptions and amendments noted below.

[2]Assumed to consist of 16 people of whom six are at the division level, five (including two people who work on special projects) are in the Buying Branch, three are in the Contractor Performance Branch, and two are in the Purchase Services Branch. Each person was assumed to contribute 1,759 "productive" man-hours per year (see Chapter VIII, Section B, of this report).

[3]Assumed to consist of nine employees, each contributing 1,759 "productive" man-hours per year (see Chapter VIII, Section B, of this report).

[4]Total man-hours reported for the Buying Sections plus an allowance for three people on the branch staff who performed work directly related to buying operations (e.g., terminations). This allowance was 3,957 man-hours, or three people working at the rate of 1,759 man-hours per year (see Chapter VIII, Section B, of this report) for nine months.

[5]Total man-hours reported for Document Production except that reported under "Administrative and Other."

(Continued on following page)

Table XIII-A (Continued)

(6) Total "Administrative and Other" Time reported for the Purchase Services Branch during the period equalled 21,001 man-hours. This included the time of the Purchase Services Branch Director and his immediate staff, which was assumed to consist of two people working at the rate of 1,759 man-hours per year (see Chapter VIII, Section B, of this report) for eight months, or consisting of 2,345 man-hours. The remaining 18,656 man-hours were prorated between Records and Contract Files based on the staffing in each unit on 31 March 1960.

(7) Total man-hours reported for the Contractor Performance Branch less an allowance for the Contractor Performance Branch Director and his immediate staff. The allowance was computed by assuming that the man-hours of the Contractor Performance Branch Director and his immediate staff consisted of three people working at the rate of 1,759 man-hours per year (see Chapter VIII, Section B, of this report) for nine months, or consisting of 3,957 man-hours.

Table XIII-B

Labor costs per "productive" man-hour

Grade	Cost per man-hour	Organizational unit[1]						
		Directors and their staffs	Control	Buying	Document Production	Records	Contract Files	Contractor Performance
Commander	$7.33	1						
Lieutenant	4.66	3						
GS - 13	7.11	1						
GS - 12	6.09	1						
GS - 11	5.24	1		5				
GS - 9	4.32	2		12				
GS - 7	3.66			6	1			
GS - 5	3.05	3	1	21	2	1		4
GS - 4	2.72	4	2			2		5
GS - 3	2.55		3	6	34	5	1	17
GS - 2	2.39		2	1	9		6	
GS - 1	2.20		1					
Total personnel		16	9	51	46	8	7	26
Average cost per man-hour		$4.276	$2.569	$3.564	$2.565	$2.655	$2.413	$2.660

[1] Manning based on SPCC Manpower Listing, SECNAVINST 5320.4, 31 March 1960.

3. Workloads

Virtually all of the workload of the Purchase Division varies with purchase actions. There are several ways of classifying purchase actions. The classification used in this analysis, and the symbols used for each are:

Classification[1]	Symbols
Purchase Orders Not Processed By Buying[2]	H_h and H_p
Other Unpriced Purchase Orders	J_h and J_p
Priced Purchase Orders	
Negotiated Contracts	K_h and K_p
Advertised Contracts	L_h and L_p

No distinction is made between H-cog and P-cog purchase actions, since the unit costs for H-cog and P-cog purchase actions of a given type do not appear to differ significantly. There are important cost differences between the different types of purchase actions.

The only costs in the Purchase Division which are not associated with one of the above workload variables are the costs treated as fixed and denoted by the subscript, f. Since these costs are not related to specific workload variables (in this analysis) they do not involve a problem of workload measurement.

The most accurate and useful counts of purchase actions processed by the Purchase Division appear to be those counts which are made in the

1 For detailed definitions see Volume I, Chapter IV, Section B.2.

2. These consist of unpriced purchase orders which are processed in a simplified fashion. In particular, the purchase orders are prepared by Document Production without going through the Buying Branch. As has been previously explained, most purchases are processed by the Buying Branch before going to Document Production for typing and reproduction.

Document Production Section. Therefore, this analysis relies primarily upon those counts. Table XIII-C shows statistics on purchase actions as counted in the Document Production Section and reported in the monthly Purchase Division Work Measurement Reports. The statistics cover each of the periods for which man-hour data were given in the preceding section of this chapter. For each period, the table shows the number of each type of purchase document received by the Document Production Section and the number of each type of purchase document processed by the Document Production Section. Statistics on documents received differ from those on documents processed for any period due to changes in the numbers of "in-process" documents during the period.

It will be noted that the workload variable statistics in Table XIII-C are expressed in documents rather than line items. Measures of the workload variables in other divisions are expressed in line items, since they are usually the more significant. However, in the Purchase Division the workloads in all of the organizational units appear to be better expressed in terms of documents.

For certain uses of the cost data it may be desirable to convert from documents to line items or vice versa, on the basis of historical experience. Factors were determined for converting documents to line items. These factors were computed from line item and document counts made by the Control Unit and covering fiscal year 1960. The factors are shown below:

Source document	Purchase documents per line item purchased
Requisitions for NSI Items	0.586
Requisitions for NIS Items	0.905
All Requisitions	0.673
Stock Replenishment Recommendations	0.504
All Requisitions and R.R.'s	0.579

Table XIII-C

Purchase documents processed[1]

Type of document	Period 7/59 - 6/60 Received	7/59 - 6/60 Processed	7/59 - 3/60 Received	7/59 - 3/60 Processed	8/59-3/60 Received	8/59-3/60 Processed
Purchase orders not processed by buying[2]	10,190	10,190	7,640	7,640	7,061	7,061
Other unpriced purchase orders[2]	6,272	6,327	4,360	4,369	4,003	4,028
Priced purchase orders	25,355	25,345	19,272	19,333	17,403	17,422
Negotiated contracts	3,743	3,787	3,033	3,102	2,724	2,755
Advertised contracts	835	836	674	694	602	613
Total purchase actions	46,395	46,485	34,979	35,138	31,793	31,879

[1]Source: Monthly Purchase Division Work Measurement Reports, Fiscal year 1960, except as noted.

[2]Only the total number of unpriced purchase orders is reported in the Purchase Division Work Measurement Reports. Unofficial monthly data on the number of unpriced purchase orders sent directly to the Document Production Section rather than processed through the Buying Branch for period, October 1959 through June 1960, were obtained from the supervisor of the Control Unit. From this, the ratio of such documents to total unpriced purchase orders received by the Document Production Section was computed. The number of such documents received by Document Production during July, August, and September, 1959, was computed by assuming that this ratio held for those months. It was assumed that the number of such documents processed was the same as the number received. The figures for other unpriced purchase orders are the reported figures for total unpriced purchase orders minus the calculated figures for purchase orders not processed by the Buying Branch.

4. Man-Hours Corresponding to Workloads

a. General

In this section each of the organizational units in the Purchase Division is considered separately. For each unit the workloads and their corresponding costs were identified and the man-hours traceable to each of the workloads were calculated. From these, estimates of future man-hours as functions of the workloads were developed.

Average productivities during the periods covered by the data were used to estimate future long-run man-hours corresponding to each of the workloads. Average productivities were employed because activity rates in this division appeared to be high, indicating that there was little excess capacity. The information on elapsed times that was developed (see Section E of this chapter) also indicated that there was little excess capacity. It was assumed on the basis of this that management would act so as to maintain the observed average levels of productivity.

b. Directors and Their Staffs

Since these personnel were considered to be independent of workloads over the range of workloads being considered, their costs were treated as fixed and were denoted by the subscript, f.

c. Control

The significant workload for this organizational unit was total purchase actions. There did not appear to be significant differences in the man-hours required per unit for the various types of purchase actions. During fiscal year 1960, the Control Unit handled 46,395 purchase actions, as measured by receipts in the Document Production Section, and spent 15,831 man-hours (see Table XIII-A). Thus, the average time required per purchase action was 0.341 man-hour.

d. Buying

This organizational unit handled all purchases except those unpriced purchase orders which were routed directly from the Control Unit to the Document Production Section. The procedures used in processing the purchases depended upon many factors. Some of the more obvious ones were:

(1) Type of input document (Requisition or R.R.).

(2) Cognizance of material (H-cog or P-cog).

(3) Type of material (electrical, mechanical, internal combustion engine, or standard item).

(4) Type of purchase document (unpriced purchase order, priced S-order, delivery order, normal priced purchase order, formal negotiated contract, or advertised contract).

(5) Existing contractual arrangements (open end contract, min-max contract, or nothing).

(6) Type of buy (competitive or sole source).

(7) Size of purchase (dollar value).

(8) Price information available (price list available, telephone request for quote adequate, or written request for quote required).

(9) Eligibility of suppliers (whether or not only "small businesses" are eligible suppliers).

Many other factors could be added. Most of these factors are related to one another in a rather complex fashion. It was considered impractical to include all or most of these factors as separate workload variables. Thus, it was necessary to select a small number which appeared to be the most significant.

Discussions were held with personnel in the Purchase Division to determine which of the possible workload variables appeared to be the most significant in terms of man-hours required per purchase action. It appeared that the type of purchase document was the most significant classification of workload and that the other important classifications were highly correlated with the type of purchase document. Moreover, it was felt that the average man-hours required per purchase action differed significantly between only two types of purchase document:

(1) Purchase orders processed by the Buying Branch. The average man-hours required per unit of each type of purchase order, such as unpriced purchase order, priced S-order, delivery order, and normal purchase order, were felt not to differ significantly.

(2) Formal contracts. It was felt that the average man-hours required were about the same for advertised contracts as for negotiated contracts.

Therefore, the workload variables selected for Buying were total purchase orders processed by the Buying Branch and total formal contracts.

All of the Buying Sections except the Priority Purchase Section process both formal contracts and purchase orders. However, the Priority Purchase Section works almost exclusively on purchase orders. During the July 1959 through March 1960 period, 33.4% of all purchase actions in the Buying Branch were handled by the Priority Purchase Section.[1] From these facts the workload of the Buying Sections during the period, as measured by receipts in the Document Production Section and shown in Table XIII-C, can be apportioned between the Priority Purchase Section and the other Buying sections as follows:

	Processed in Priority Purchase Section	Processed in Other Buying Sections	Total
Formal Contracts	--	3,707	3,707
Purchase Orders	9,131	14,501	23,632
Total	9,131	18,208	27,339

Also, according to the monthly Purchase Division Work Measurement Reports, "productive" man-hours during the July 1959 through March 1960 period for Buying were as follows:

Priority Purchase Section	9,711
Other Buying Sections	46,844
Total	56,555

1 Monthly Purchase Division Work Measurement Reports, Fiscal Year 1960.

From the statistics for the Priority Purchase Section, the average time required per purchase order was estimated to be 9,711 ÷ 9,131 or 1.064 man-hours. The average time required per formal contract is, thus, estimated to be (46,844 - 1.064 x 14,501) ÷ 3,707 or 8.475 man-hours. (These estimates are in close agreement with independent estimates supplied by Purchase Division personnel.)

e. Document Production

Estimates of the relative average times required to process each type of document in each of the units in the Document Production Section were obtained from the section and unit supervisors. These estimates were partially based on time study data which had been obtained. The total times for each type of purchase document, adjusted to include the total man-hours in the Document Production Section during the July 1959 through March 1960 period, are shown in Table XIII-D. The table also shows the number of each type of document processed during the period, as shown in Table XIII-C and reported in the monthly Purchase Division Work Measurement Reports, and the computed total hours for each type of purchase document.

It was considered impractical to include invitations for bids, requests for quotes, and shipping instructions as separate workload variables. Therefore, the effort spent on these documents was prorated to purchase documents. The following assumptions were made in making these allocations:

(1) All invitations for bids pertain to advertised contracts.

(2) On the average one request for quote is required per negotiated contract. The remaining requests for quotes pertain to purchase orders processed by the Buying Branch.

(3) Shipping instructions are equally likely for all types of purchase documents.

The average man-hours pertaining to each type of purchase document were then computed and are shown in the second half of Table XIII-D.

There are significant differences in the average processing times between each of the four classes of documents. In the original calculations the class, "other purchase orders, " was segregated into priced and unpriced. However, the difference between these classes did not appear to be large enough to justify the inclusion of another workload variable.

Table XIII-D

Document Production Section -- man-hours per document

Type of document	Man-hours per document	Number of documents	Total man-hours
Unpriced Purchase Orders not processed by Buying Branch	0.907	7,640	6,928
Other Purchase Orders	1.114	23,702	26,404
Negotiated Contracts	1.524	3,102	4,726
Advertised Contracts	1.451	694	1,007
Invitations for Bids	3.264	693	2,262
Requests for Quotes	1.125	8,063	9,067
Shipping Instructions	0.762	5,709	4,348
Total			54,742

Type of purchase document (1)	Man-hours per document	Number of documents	Total man-hours
Unpriced Purchase Orders not processed by Buying Branch	1.030	7,640	7,873
Other Purchase Orders	1.473	23,702	34,916
Negotiated Contracts	2.772	3,102	8,598
Advertised Contracts	4.834	694	3,355
Total		35,138	54,742

(1) Including a proration of invitation for bids, request for quotes, and shipping instructions.

f. Records

Discussions with personnel in the Records Unit indicated that about 50% of their work consists of maintaining bidders' lists and performing other duties which are independent of the selected workload variables over the range of workloads being considered. The costs of such work are treated in this analysis as fixed. The remaining effort was approximately equally divided between work related to the processing of advertising contracts and work related to the processing of other purchase actions which are handled by the Buying Branch. The estimated man-hour costs for the August 1959 through March 1960 period, expressed in units of purchase documents processed by the Document Production Section during the period, are shown in Table XIII-E.

Table XIII-E

Records Unit--man-hours per document

	Percent of total man-hours	Man-hours	Purchase documents	Man-hours per purchase document
Fixed	50.0	4,974	--	--
Advertised Contracts	25.0	2,488	613	4.059
Other Purchases processed by the Buying Branch	25.0	2,488	24,205	0.103
Total	100.0	9,950		

g. Contract Files

The significant workload for this organizational unit was total purchase actions. There did not appear to be significant differences in the man-hours required per unit for the various types of purchase actions. From the man-hour data in Table XIII-A and the purchase documents processed count made by the Document Production Section for the August 1959 through March 1960 period, the average time required per purchase action was 8,706 ÷ 31,879 or 0.273 man-hour.

h. Contractor Performance

There was little reason to presume that the workload in this organizational unit was related to the method of procurement. Follow-ups appeared to be primarily a function of the contractors selected rather than the type of purchase document. On the other hand, some differences between procurements for stock replenishment and procurements to satisfy requisitions might have been expected due to differences in priorities. However, investigation showed that there was not a significant difference in the average man-hours per unit spent on procurements for requisitions and procurements for stock replenishment. Therefore, the workload variable selected for the Contractor Performance Function was total purchase actions, which was measured by purchase documents processed by the Document Production Section. From the figures given in Table XIII-A and XIII-C, the average time per purchase document was estimated to be $41,885 \div 35,138$ or 1.192 man-hours.

5. Labor Costs Corresponding to Workloads

The estimated long-run labor costs corresponding to each of the workloads in each organizational unit are the product of the man-hours corresponding to the workload and the labor costs per man-hour. The man-hour estimates for each workload in each organizational unit were developed in Sections B.1 and B.4 of this chapter. The labor costs per man-hour for each unit are shown in Table XIII-B. The resulting estimated long-run labor costs corresponding to each workload are shown in Table XIII-F.

C. Paper Costs

When procurements are made at SPCC certain purchase documents are completed. These include purchase orders, contracts, invitations for bids, request for quotes, notices of awards, contract modifications, shipping orders, and other documents. They may be sent to contractors, consignees, Naval Regional Accounts Offices, Inspectors of Naval Material, other divisions of SPCC, and other appropriate offices which desire information on procurements.

The documents may range in size from one to twenty-five pages, They may be preprinted outside of SPCC, offset reproduced at SPCC, or some combination of both. The costs encompassed in this discussion of paper costs include the costs of the actual paper and printing, whether done internally in or externally to SPCC. In the case of the offset printing, however, the costs do not include the costs of typing the duplimats. These are covered in the analysis of labor costs for the Document Production Section of the Purchase Division.

Table XIII-F

Labor costs

Organizational unit	Workload symbols: Variables $H_h + H_p$ (Costs per unit of workload)	$J_h + J_p$	$K_h + K_p$	$L_h + L_p$	Constant Subscript f (Costs per year)
Directors and their staffs					$120,344
Control	$0.876	$ 0.876	$ 0.876	$ 0.876	
Buying		3.792	30.205	30.205	
Document Production	2.642	3.778	7.110	12.399	
Records		0.273	0.273	10.777	13,206
Contract Files	.659	.659	.659	.659	
Contractor Performance	3.171	3.171	3.171	3.171	
Total	$7.348	$12.549	$42.294	$58.087	$133,550

Estimated long-run and short-run unit costs of paper were derived from the actual purchase prices of all forms, duplimats, and envelopes purchased externally to SPCC and from per unit charges developed for NSD Mechanicsburg's Reproduction Department. The cost of paper which is procured externally is small and was assumed to vary directly with the number of documents consumed, both in the long run and in the short run. However, separate long-run and short-run unit costs were developed for NSD Mechanicsburg's Reproduction Department. Labor and equipment costs were included only in the long-run unit costs. The total long-run and short-run unit costs which were developed are shown in Table XIII-H.

Samples of the particular types of purchase documents employed were obtained and analyzed for average number of pages, type of form, and quantity of distribution. Appropriate extensions of unit prices were made and cost estimates by type of document were developed. Document classes corresponding to the workload variables used in the analysis of the Purchase Division were selected and costs per purchase document were estimated to the nearest ten cents. These costs per purchase document are shown in Table XIII-G.

Table XIII-G

Purchase document costs

Document	Workload variable	Long-run unit cost	Short-run unit cost
Purchase Orders	$H_h + H_p + J_h + J_p$	$ 1.80	$ 1.00
Negotiated Contracts	$K_h + K_p$	5.20	2.70
Advertised Contracts	$L_h + L_p$	14.90	8.10

The long-run unit costs of the documents in Table XIII-G treat labor costs as variable. The short-run costs do not. In the short run, the labor costs corresponding to the reproduction of these documents are fixed and equal $48,642 (see Table XV-D, footnote 4).

Table XIII-H

Forms and supplies--unit costs

Forms	Long-run unit cost	Short-run unit cost	Source
Contract Printed (Philadelphia)			
1 Side	$ .004	$ .004	(1)
2 Sides	.005	.005	(1)
SPCC Offset			
1 Side	.005	.002	(2)
2 Sides	.012	.002	(2)
SPCC Overprint			
1 Side	.005	.000	(2)
2 Sides	.010	.000	(2)
Paper	.002	.002	(1)
Duplimats			
Blank	.020	.020	(1)
Preprinted	.056	.056	(1)
Mailing Envelopes	.012	.012	(1)
Purchase Folder	.058	.058	(1)
Request for Purchase	.034	.034	(1)
Priority Routing Slip	.013	.013	(1)

Sources:

(1) SPCC actual purchase price

(2) Cost derived from NSD Mechanicsburg, Semi-Annual Printing Plant Report, 30 June 1960.

D. Cost Models

1. General

The cost models in this chapter include labor costs and paper costs. No machine rental costs are incurred in the Purchase Division.

2. Short-Run Costs

All labor costs are treated as fixed in the short run. The estimated total labor costs in the Purchase Division at current annual rates are determined by multiplying the unit labor costs (as shown in Table XIII-C) by the number of units processed during fiscal year 1960 (as shown in Table XIII-F). The results are shown in Table XIII-I.

Table XIII-I

Total labor costs

Workload symbol variables	Units processed in fiscal 1960	Unit labor costs	Total labor costs
$H_h + H_p$	10,190	$ 7.348	$ 74,876
$J_h + J_p$	31,672	12.549	397,452
$K_h + K_p$	3,787	42.294	160,167
$L_h + L_p$	836	58.087	48,561
Constant			
Subscript f	--	--	133,550
Total	46,485		$814,606

Paper costs are treated as partly variable and partly fixed in the short-run. The costs are shown in Table XIII-G. Total short-run costs are the sum of labor costs and paper costs. The short-run cost model for both labor costs and paper costs is:

$$T_s = 1.00 (H_h + H_p + J_h + J_p) + 2.70 (K_h + K_p) + 8.10 (L_h + L_p) + 863,248_f$$

where

T_s = total short-run annual dollar costs treated in this chapter, and where the other symbols are as shown in the list given in the front of this volume.

3. Long-Run Costs

The estimated long-run labor and paper costs for the Purchase Division are summarized in Tables XIII-F and XIII-G, respectively, of this chapter. The cost model is:

$$T_l = 9.15 (H_h + H_p) + 14.35 (J_h + J_p) + 47.49 (K_h + K_p) + 72.99 (L_h + L_p) + 133,550_f$$

where

T_l = total long-run annual dollar costs treated in this chapter and where the other symbols are as shown in the list given in the front of this volume.

For certain uses of the cost data it may be desirable to group all categories of purchase actions (i.e., not to distinguish between the various types of purchase documents). If the symbol, Q, is used to represent $H_h + H_p + J_h + J_p + K_h + K_p + L_h + L_p$, and if Q is estimated by total purchase documents processed during fiscal year 1960, the equation for total long-run annual dollar costs treated in this chapter becomes:

$$T_l = 16.96Q + 133,550_f$$

The variable, Q, in the above equation may be measured in line items. Using the factor of 0.579 purchase documents per line item (see Section B.3 of this chapter), and measuring Q in line items, the equation for total long-run annual dollar costs becomes:

$$T_1 = 9.82Q + 133,550_f$$

E. Elapsed Times

1. General

In this section elapsed times for both H-cog replenishment recommendations for system stocks and H-cog requisitions for end users are discussed. These elapsed times begin when purchase requisitions and R.R.'s are logged in by the Control Unit of the Purchase Division and end when purchase orders and contracts are mailed to vendors. For certain classes of purchases some time outside of SPCC is included (i.e., when requests for quotations or invitations for bids are mailed, and vendors prepare bids or quotes). These times are treated separately.

There is a great deal of variation in the elapsed times for individual purchase documents. The basic aim of this analysis is to explain or attribute causes to this variation. Much of the variation in elapsed times appears to be caused by differences in the nature of individual documents. Other sources of variation appear to be independent of the nature of documents but nevertheless seem to vary over time. Based on current theories of processing and the development of queues, it is reasonable to expect that some of the variation in elapsed time is caused principally by variation in the level of workload input and of processing capability, or capacity. Furthermore, the effects of workload level and processing capability upon elapsed times should become more apparent as the effects of differences in elapsed time caused by individual differences in documents are taken out. In this analysis the causes of variations in elapsed times were determined first by isolating the major classes of individual differences between purchase documents which affected elapsed times and then by estimating the effects of workload levels and processing capability upon elapsed times. The analysis is based upon an extensive sampling operation which was conducted by the research team.

2. Data Utilized

The Control Unit in the Purchase Services Branch of the Purchase Division maintains a card file of all procurements made at SPCC. Each card contains information as to whether the purchase was for a requisition or R.R.;

whether it was executed by an advertised contract, negotiated contract, or purchase order; which buying section and buyer completed it; who the vendor was; and various processing dates, from which it is possible to determine processing time through various segments of the Purchase Division operation. The cards are sequenced according to consecutively assigned control numbers, which facilitated systematic sampling of the files.

Two rather large samples from these control decks were made. The first, which was rather extensive, covered all H-cog purchases for fiscal year 1960 and included every 50th card, or 2% of all H-cog purchases. Approximately 700 cards were sampled. (A small number of cards which had missing dates or other peculiarities were excluded from the analysis.) About 60 cards per month were in the sample.

The second sample, which was fairly intensive, covered R.R.'s for the first 7 months of fiscal year 1961 and requisitions for the first 3 months. It included every 10th card or 10% of all H-cog purchases. Approximately 1450 cards were sampled. (Again a small number of cards were rejected for various reasons.) For the periods covered, this sample included about 40 requisitions and 30 R.R.'s per week or about 300 per month. All dates on each card, including the dates for receipt, preparation of request for quote, mailing of request for quote, preparation of award, and mailing of purchase order or contract, were recorded.

3. Analysis of Data

Figures XIII-A and XIII-B illustrate the range and dispersion of individual differences observed in the samples of R.R.'s and requisitions, respectively. These figures are based on the data from the first sample. It will be observed that considerable dispersion does exist. In fact, there is some evidence to suggest a bimodal distribution in both figures, which is an indication that more than one underlying cause of variation may exist.

In order to analyze some of the differences between purchase documents, it is necessary to review the nature of the procurement process for different types of purchases. In general, two broad types of operations directly concerned with a purchase go on within the Purchase Division. They are Buying and Document Production. A third class of operation, which can broadly be classed as "follow-up," is essentially ancillary and has little effect upon the elapsed times to complete purchases within SPCC. The nature of the Buying and Document Production operations has already been described (see Section A of this chapter). Buying is essentially a decision-making operation, whereas Document Production is a clerical operation. They differ in processing times and in types of queues for various types of purchases.

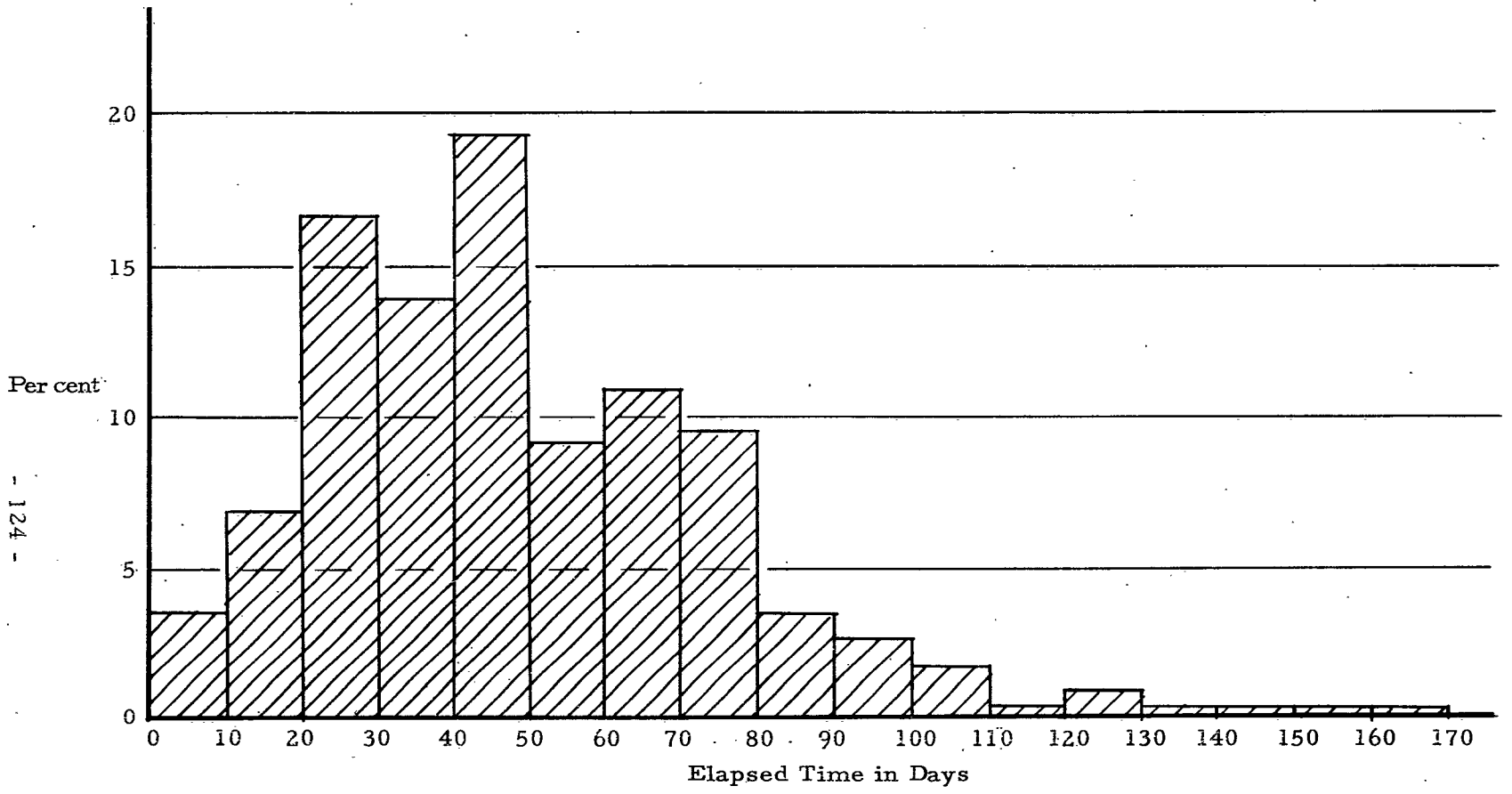

Figure XIII-A. H-cog R.R.'s - Distribution of elapsed times.

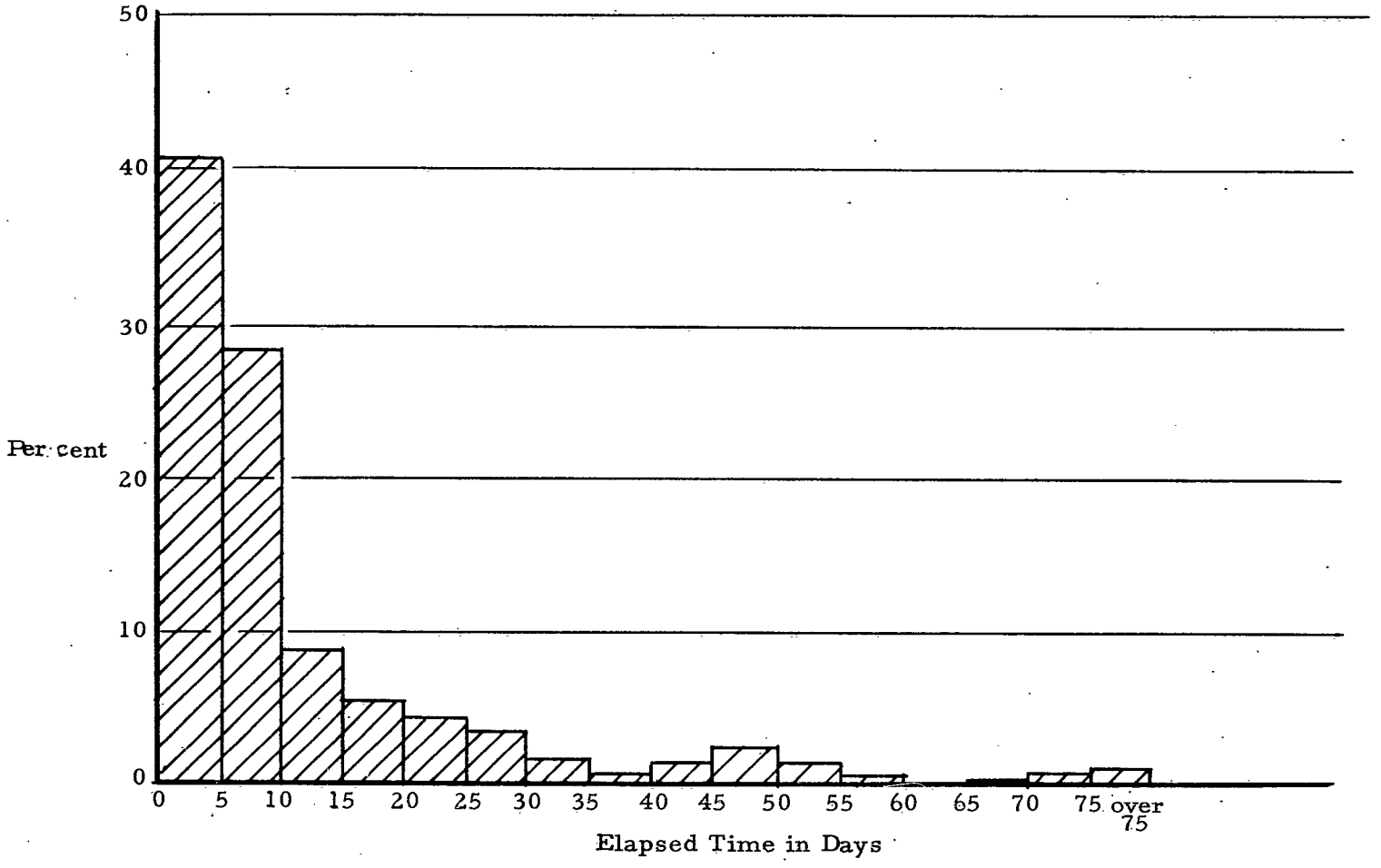

Figure XIII-B. H-cog requisitions - Distribution of elapsed times.

Now given this description of the nature of the purchasing operation the relevant question becomes: What are the important distinctions which will tend to isolate or remove the differences between classes of documents? Expressed alternatively, a classification of purchases is desirable such that differences within classes are small and differences between classes are large.

The distinctions of importance are: 1) the type of input document, 2) the type of output document, and 3) whether a quote or bid must be obtained.

With respect to input document, a purchase may be precipitated by either an R.R. (if it is for stock) or a requisition (if it is for an end user). Further, requisitions have assigned priorities which are possible causes of differences. Some differences also exist in the method of processing and queue discipline for R.R.'s and requisitions. This difference in processing does not exisit, however, for different priorities of requisitions. (The sample data tend to support this.) Therefore, the important distinction by types of input documents is between R.R.'s and requisitions. This distinction influences elapsed times in both the Buying and the Document Production operations.

The second class of distinctions which influences elapsed time is the type of output document. A procurement can be accomplished by an advertised contract, by a negotiated contract, or by a purchase order; and purchase orders themselves may be differentiated according to whether they are, or are not, processed by the Buying Branch. This class of distinctions does not materially influence the elapsed time through either of the two operations. It does, however, influence time outside SPCC. It turns out that, when a "request for quote" is sent out, the time which it takes the contractor to complete and return it is a function of the type of document.

This classification by type of document also influences the number of times a document goes through a process. For instance, all advertised contracts must go through Document Production twice -- once to produce invitations for bids, and once for the awards. Another category, purchase orders not processed by Buying, is specifically distinguishable because this category is not processed by the Buying Branch.

The third class of distinction is whether or not a "request for quote" or invitation for bid is sent out. If one is sent out, the additional time outside of SPCC for the contractor to complete it substantially affects

the elapsed time. In addition, the time within SPCC is affected because two documents must be prepared by the Document Production Section, as was indicated above in the case of an advertised contract.

All of the conclusions presented above with respect to importance of various classes of purchases and significant time differences were clearly supported by the elapsed time data which were collected.

At this point some comment should be made about the actual times recorded. The dates on the cards sampled enabled estimates of elapsed time to be made for certain defined time periods. These time periods do not exactly correspond to the times within the Buying Branch, the Document Production Section, and the time outside of SPCC.

In the list below three classes of procurements are shown. Beneath each one on the left are the end points of the intervals sampled from the cards and on the right are the operations which have been assigned to the interval.

<u>For purchase orders not processed by the Buying Branch</u>

Prepare award to mail purchase order - Document Production

<u>Others--no request for quote or invitation for bid</u>

Received to prepare award - Buying

Prepare award to mail purchase order or contract - Document Production

<u>Others--with request for quote or invitation for bid</u>

Received to prepare request for quote or invitation for bid - Buying

Prepare request for quote or invitation for bid to mail request for quote or invitation for bid - Document Production

Mail request for quote or invitation for bid to prepare award - Outside SPCC

Prepare award to mail purchase order or contract - Document Production

The total elapsed time for each type of document is completely accounted for by the times recorded. The use of the nominal terms, Buying and Document Production, however, differs slightly (with respect to their end points) from the actual times in the Document Production Section, the Buying Branch, and outside of SPCC. For instance, time outside of SPCC is considered to continue up to preparation of award. It is probably true that at least some of this time occurs in the Buying Branch, although no data are available to show this. However, the errors involved can be ignored since they are generally small and since they tend to be cancelled out in the over-all times.

Table XIII-J shows the average elapsed times for the purchase classes which were differentiated. Note that significant differences existed for the time outside of SPCC for various categories of purchase. This is reasonable considering the relative complexities of the purchases and the time that the contractor would have to spend on them. It should also be noted that these are mean times based on the sample over the 19-month period.

To summarize what has been indicated so far, elapsed times for purchases are a function of: 1) the category of purchase (requisition, or R.R.), 2) whether or not a request for quote is made, 3) kind of purchase (i.e., advertised contract, negotiated contract, purchase order, purchase order not processed by Buying), and 4) some measure of the workload volume in relation to processing capability.

4. The Model

The problem at this point is to construct the generalized model. The average elapsed time treated in this discussion of the Purchase Division equals the average time in the Buying Branch plus the average time in the Document Production Section plus the average time outside of SPCC.

The average time for each one of these segments is the time for one pass of each type of document multiplied by the number of passes and weighted by the percentage or fraction of each type of document. To make the model more specific, and translate it into mathematical terminology, some symbols must be defined. Consider the elapsed time for R.R.'s or stock replenishments. First let:

U_3 = The ratio of procurements for stock which are not processed by the personnel in the Buying Branch to the total procurements for stock.[1]

1 Under present procedures, U_3 is 0. However, it is conceivable that a decision could be made to change it to some positive value.

Table XIII-J

Average elapsed times

		Based on sample size	Average time
(a)	Buying--requisitions	720	3.2 days
(b)	Buying--R.R.'s	1137	9.5 days
(c)	Document Production--requisitions	1098	5.8 days
(d)	Document Production--R.R.'s	1666	8.5 days
(e)	Time outside of SPCC--purchase orders	504	25.9 days
(f)	Time outside of SPCC--negotiated contracts	79	37.5 days
(g)	Time outside of SPCC--advertised contracts	53	46.9 days

U_4 = the ratio of procurements for stock which are purchase orders and have requests for quotes to total procurements for stock.

U_5 = the ratio of procurements for stock which are negotiated contracts and have requests for quotes to total procurements for stock.

U_6 = the ratio of procurements for stock which are advertised contracts to total procurements for stock.

These U's are variables whose values are determined by large numbers of separate decisions routinely made at SPCC. These decisions are influenced by the nature of the workload input and by policies and procedures at SPCC. It is important to note that these U's can take on almost any set of values depending on these decisions. Estimates of the U's for current operations will, however, be developed later.

Also let C_1, C_2, and C_3 be the elapsed times outside of SPCC for purchase orders, negotiated contracts, and advertised contracts, respectively (corresponding to e, f, and g of Table XIII-J). These terms are considered constants since they are essentially independent of any decision or action within SPCC.

Now, let W_1 be a measure of the workload relative to capacity for the Buying Branch, and let W_2 be a measure of the workload relative to capacity for the Document Production Section. Specifically let:

W_1 = the ratio of the number of buying actions received in the Buying Branch of the Purchase Division to nonadministrative "productive" man-hours per month in the Buying Branch;

and let: W_2 = the ratio of the number of documents received in the Document Production Section of the Purchase Division to nonadministrative "productive" man-hours per month in the Document Production Section.

Operationally, the values of the numerators and denominators which form W_1 and W_2 can be obtained from the Purchase Division Work Measurement Reports. The numerator of W_1 is the total of all buying actions received in all sections of the Buying Branch. The denominator is the total

of all "productive" man-hours in the Buying Sections (that is, administrative man-hours are excluded). The numerator of W_2 is the total of all the documents received in the Document Production Section excluding contract modifications and mats production. This includes priced and unpriced purchase orders, negotiated contracts, advertised contracts, requests for quotes, invitations for bids, and shipping instructions. The exclusion of contract modifications and the production of mats from the numerator of W_2 is based on the fact that, although they are counted at this point, the major effort associated with them is not accomplished in this section. The denominator is the total of all "productive" man-hours in the Document Production Section except administrative man-hours. In general, administrative man-hours have been removed from both denominators, since they represent "nonproductive" work. It should be noted that after March 1960, man-hours were not reported in Purchase Division Work Measurement Reports so that man-hour data were obtained from other accounting records.

The model which represents the average elapsed time in the Purchase Division for R.R.'s can be expressed in the form:

$$t_1 = (1 - U_3)\, f_1 (W_1) + (1 + U_4 + U_5 + U_6)\, g_1 (W_2) + C_1 U_4 + C_2 U_5 + C_3 U_6$$

where t_1 = average elapsed times in calendar days for R.R.'s in the Purchase Division.

The terms denoted by $f_1 (W_1)$ and $g_1 (W_2)$ represent elapsed times for R.R.'s in the Buying Branch and in the Document Production Section, respectively. These times are functions of workload volumes, although the nature of the functions is not as yet defined. The terms denoted by C_1, C_2, and C_3 are constants which represent times outside of SPCC for various types of purchases. The terms denoted by $(1 - U_3)$, $(1 + U_4 + U_5 + U_6)$, U_4, U_5, and U_6 represent the frequency with which each of the times is incurred.

All documents go through the Buying Branch once except that category defined by U_3. All documents go through the Document Production Section at least once. Those with request for quotes or those which are advertised go through twice. These are represented by U_4, U_5, and U_6 in the second term of the model.

Again by way of explanation, the model says the average elapsed time is the sum of the average time in the Buying Branch, the average time in the Document Production Section, and the average time outside of SPCC. The coefficients are appropriately chosen to produce the correct weighted averages.

A similar model can be constructed for requisitions. First let:

U_7 = the ratio of procurements for end users (requisitions) which are not processed by personnel of the Buying Branch to total procurements for end users.

U_8 = the ratio of procurements for end users which are purchase orders and have requests for quotes to total procurements for end users.

U_9 = the ratio of procurements for end users which are negotiated contracts and have requests for quotes to total procurements for end users.

U_{10} = the ratio of procurements for end users which are advertised contracts to total procurements for end users.

Let the C's and the W's be as before; however, call the new functions of the W's, $f_2(W_1)$ and $g_2(W_2)$.

The average elapsed time for requisitions in the Purchase Division can be written in the form:

$$t_2 = (1 - U_7) f_2(W_1) + (1 + U_8 + U_9 + U_{10}) g_2(W_2) + C_1 U_8 + C_2 U_9 + C_3 U_{10}$$

The meanings of the terms are analogous to those in the equation for stock replenishments.

The problem which remains is to estimate the U's, the W's, and the functions of the W's. The estimated values of the C's were given in Table XIII-J along with estimates of the mean values for the functions of the W's. The U's were estimated both from total counts for fiscal year 1960 and from sampled data. For instance, procurements for end users not processed by Buying, (i.e., U_7) were estimated from total counts. On the other hand U_5,

the fraction of procurements for stock which are negotiated contracts and have requests for quotes, was estimated from the actual number of negotiated contracts and the percentage of sampled negotiated contracts which had requests for quotes. The estimated current values of the U's are $U_3 = 0$, $U_4 = .498$, $U_5 = .096$, $U_6 = .038$, $U_7 = .417$, $U_8 = .092$, $U_9 = .003$, $U_{10} = .001$.

The W's were estimated based on Purchase Division Work Measurement Reports from 1 July 1959 through 10 February 1961 or about 19 months of data. The estimates of the mean W's are: $W_1 = 0.736$ and $W_2 = 0.943$.

Up to this point the description of the attempt to develop the relationships between workload and elapsed time has been deferred. The task of developing this relationship involved, in fact, most of the effort devoted to the area of elapsed time prediction. As was pointed out earlier, there were considerable a priori grounds for suspecting that a relationship existed. Also, observations of the research team indicated that productivity levels in the Purchase Division were high, suggesting that elapsed times were sensitive to changes in workload levels. The practical problem was one of eliminating or pointing out other causes of variation which tended to mask the workload relationships.

The basic technique used in the analysis to develop the models was an empirical one: the two rather large elapsed time samples were used to develop the inputs necessary to construct the functional relationships between workload and elapsed time. What has been called the second or intensive sample was merely a large enough sample to make looking at weekly data practical. The other, or extensive sample, covered a long enough period to give sufficient points for looking at monthly data.

As has been pointed out, the analysis of the data removed much of the variation due to differences between classes of purchases. It was then possible to examine the elapsed time-workload relationships for: 1) R.R.'s in Buying, 2) requisitions in Buying, 3) R.R.'s in Document Production, and 4) requisitions in Document Production.

Many charts were prepared with plots of sampled elapsed times against measures of workload levels for both the Buying and Document Production operations and for both R.R.'s and requisitions. The weekly and monthly sampled average elapsed times were plotted against workload input levels both with and without time lags. Various measures of workload and capability were used. Most of the plots showed some positive correlation, but with considerable random scatter.

On the basis of these and other considerations, it was decided to use monthly data without time lags and to predict average elapsed times in terms of the measures of workload input adjusted for nonadministrative "productive" man-hours as denoted by the variables W_1 and W_2. The results are shown in Figures XIII-C and XIII-D.

Figure XIII-C is for the Buying Branch where the abscissa is W_1 (the workload per man-hour in that Branch). Figure XIII-D is for the Document Production Section and the abscissa is W_2. Note that both classes of purchases (R.R.'s for stock and requisitions for end users) are plotted on the same graphs. A typical priority situation exists, the outcome of which has been described very well in the literature.[1] In both cases the R.R. points in general fall above the requisition points, and rapidly increasing slopes for R.R.'s are observed, with somewhat lesser slopes at lower levels for requisitions.

The curves shown in Figures XIII-C and XIII-D were sketched in by eye and then fitted with mathematical functions. These curves, however, not only reflect the data shown on the figures but also some a priori estimates of lower asymptotes and reasonably expected rates of growth in the upper areas.

The functions of W_1 and W_2, which these curves expressed mathematically, are:

Buying--R.R.'s	$f_1(W_1) = 3.0 + 11.0^{W_1}$
Buying--requisitions	$f_2(W_1) = 0.5 + 4.5^{W_1}$
Document Production--R.R.'s	$g_1(W_2) = 2.0 + 6.5^{W_2^2}$
Document Production--requisitions	$g_2(W_2) = 2.0 + 4.2^{W_2^2}$

1 The characteristically described models for the situation with two classes of priority usually indicate the familiar growth curve whose slope is increasing rapidly for the lower priority items. The higher priority items usually have lower mean elapsed times with a somewhat lesser slope which does not increase nearly as rapidly as that of the lower priority items.

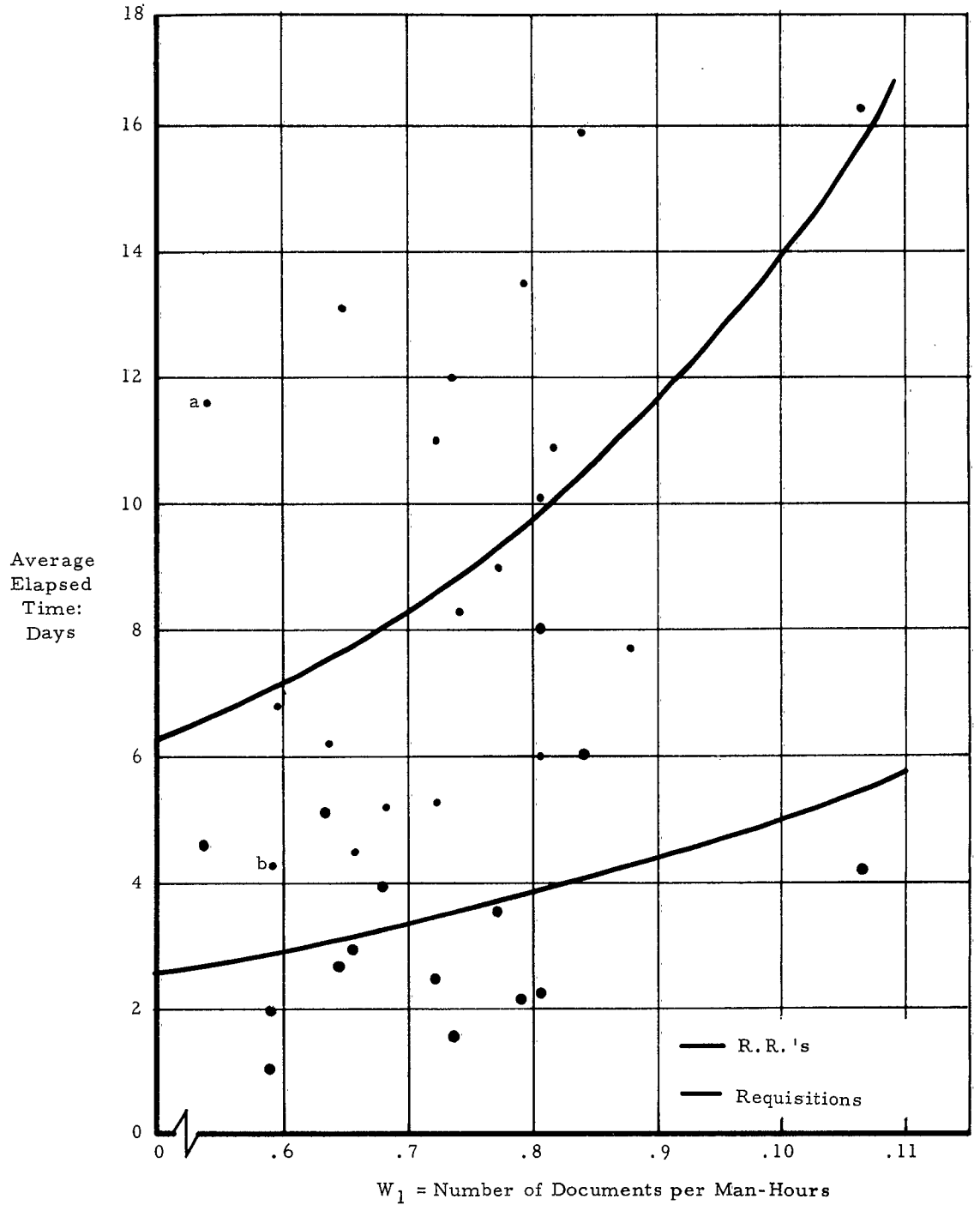

Figure XIII-C. Buying Branch - Average elapsed time for R.R.'s and requisitions vs. number of documents per man-hour - by months - July 1959 through February 1961.

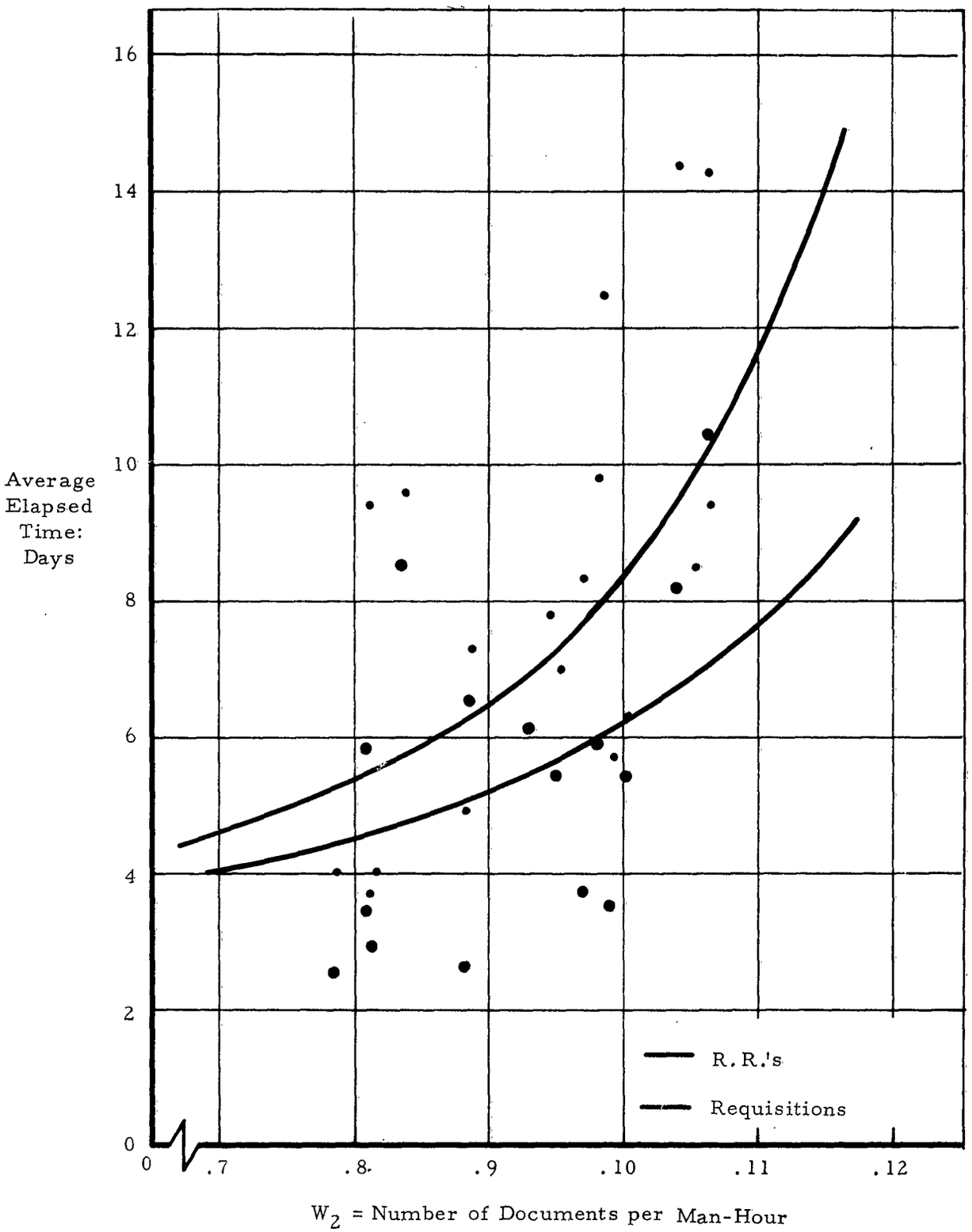

Figure XIII-D.. Document Production Section - Average elapsed times for R.R.'s and requisitions vs. number of documents per man-hour - by months - July 1959 through February 1961.

The curves drawn in Figures XIII-C and XIII-D are exactly the graphical representations of the mathematical functions represented above. It should be pointed out clearly that no preconceived notion as to the mathematical formulation was entertained. Although some a priori knowledge was employed in sketching the curves, the technique was basically empirical. The mathematical forms were selected primarily for their simplicity and accuracy of fit to the sketched line.

Considerable efforts to eliminate or stratify the class distinctions which would tend to reduce variations in observed elapsed time were made. However, some "random variation" still exists. Significant further reduction in the variance probably would not be achieved through further stratification without extensive increases in sample size. Most of the variation from the hypothesized relationship which was observed was caused by a series of individual nonrepetitive causes. Although these causes may seriously affect elapsed times, they cannot be used for predictive purposes since they are of a nonrepetitive nature.

Among the causes of this apparent variation from month-to-month are holidays and weather. The effects of holidays, or bad weather, or any other "lost time" phenomena are, in fact, quite complex. Multiple effects result. For one, there tends to be a real reduction in productivity in the period anticipating a holiday, particularly at Christmas. Of course, the reduction in man-hours worked, because of the holiday, shifts the apparent workload/man-hour relationship to a higher level, which would tend to mask the effect of the holiday. On the other hand, the actual days not worked contribute to the backlog and have a long-term and therefore more severe effect on elapsed times. This effect accounts for several of the outlying points in Figures XIII-C and XIII-D. Another cause of outlying points or variations consists of errors introduced because of small sample sizes.

As examples, consider two of the outlying points in Figure XIII-C. Point (a) which represents December of 1959 is one in which the effects of the Christmas holidays on elapsed times are particularly evident. Point (b) on the other hand represents March 1960, a month with a particularly small sample. Most of the outlying points in Figures XIII-C and XIII-D have been similarly analyzed and, for the most part, reasonable explanations can be attributed for their variance.

It is clear, however, that the relationships do exist in approximately the form that would be expected, based on a priori knowledge, and the variation of the observed sample means about the values predicted by the curves

is in general less than 50% of that value. Further, when the residual variability shown in Figures XIII-C and XIII-D is compared with the original variability of the over-all data shown in Figures XIII-A and XIII-B, it is indeed small.

If the mean values of W_1 and W_2 over the 19-month period are substituted into the functions, the following values are derived:

$$f_1(W_1) = 9.8$$

$$f_2(W_1) = 3.5$$

$$g_1(W_2) = 7.3$$

$$g_2(W_2) = 5.6$$

The minor differences between these values and those shown for a, b, c, and d of Table XIII-J are due to differences in weights (i.e., the means in Table XIII-J are weighted by sample size, whereas the means resulting from the models treat all months as if they had the same sample size), and to some slight adjustments necessary in fitting the curves.

Now that the functions for the W's have been explicitly developed, it is possible to present the complete models for the Purchase Division. Replacing the terms in the generalized models presented earlier with the actual functions of the W's and the estimates of constant values denoted by the C's, the following models are obtained:

For stock replenishments

$$t_1 = (1 - U_3)(3.0 + 11.0^{W_1}) + (1 + U_4 + U_5 + U_6)(2.0 + 6.5^{W_2^2}) + 25.9U_4 + 37.5U_5 + 46.9U_6$$

For requisitions

$$t_2 = (1 - U_7)(0.5 + 4.5^{W_1}) + (1 + U_8 + U_9 + U_{10})(2.0 + 4.2^{W_2^2}) + 25.9U_8 + 37.5U_9 + 46.9U_{10}$$

where t_1 and t_2 = averaged elapsed time in calendar days in the Purchase Division for R.R's and requisitions and where the other symbols are as defined in the list in the front of this volume.

It is important to note that the elapsed time for specific subclasses of procurements can also be estimated, using the models shown above, by adjusting the values of the U's to the specific subclasses being considered. Tables XIII-K and XIII-L show the current estimates of the U's for various subclasses of R.R.'s and requisitions along with average elapsed times predicted by the appropriate formula.

Table XIII-K

Values of U's and averaged elapsed times for various subclasses of procurements for stock

Subclass of purchases	U_3	U_4	U_5	U_6	Average elapsed time in Purchase Division
All R.R.'s	0	.498	.096	.038	39.1
Advertised	0	0	0	1	70.4
Negotiated with request for quote	0	0	1	0	61.0
Negotiated with no request for quote	0	0	0	0	16.0
All negotiated	0	0	.593	0	42.6
Purchase orders with request for quote	0	1	0	0	41.2
Purchase orders with no request for quote	0	0	0	0	16.0
All purchase orders	0	.593	0	0	35.8
Purchase orders not processed by Buying	1	0	0	0	7.3

Table XIII-L

Values of U's and averaged elapsed time for various subclasses of procurement for end users

Subclass of purchases	U_7	U_8	U_9	U_{10}	Average elapsed time in Purchase Division
All requisitions purchased	.417	.092	.003	.001	10.6
Requisitions not processed by Buying	1	0	0	0	5.6
Requisitions with requests for quotes	0	.959	.031	.010	41.2
Requisitions without requests for quotes (processed by Buying)	0	0	0	0	9.1
Emergencies	0	0	0	0	9.1
Schedules	.412	.035	.002	0	8.9
Routines	.512	.258	.006	.003	15.8

XIV. SYSTEM PLANNING DIVISION

A. Description

1. General

The System Planning Division is responsible for establishing and maintaining a responsive distribution system for all material under the inventory management of SPCC. It acts in the capacity of a staff to the Commanding Officer. The division, as of 9 November 1960, had eight Naval officers and 35 civilian employees. One officer and four civilians were at the division level. The remaining personnel were divided into the following six branches: System Procedures, Program Data, Industrial Mobilization, Advanced Logistic Research and Development, Field Service, and Provisioning Coordination. Each of the branches is briefly described below.

2. System Procedures Branch

The System Procedures Branch includes one officer and six civilians. The branch coordinates all planning and policy directives to the ships parts segment of the Navy Supply System and provides general expression of policies and plans through appropriate media. It conducts research and analyses of existing system procedures and recommends improvements. It also develops and promulgates procedures for new programs.

3. Program Data Branch

The Program Data Branch has three people. It obtains, develops, maintains, and analyzes program data to ensure logistic support of programs assigned to SPCC. It is particularly concerned with the implementation of Bushipsand Busanda mobilization and catastrophy plans applicable to SPCC, as well as with other special programs.

4. Industrial Mobilization Branch

The Industrial Mobilization Branch develops and implements plans and programs to provide industrial capacity and ensure industrial readiness to support mobilization plans for the ships parts segment of the Navy Supply System. In particular, it develops and prepares phased production schedules covering mobilization material procurement requirements. The branch includes four people.

5. Advanced Logistic Research and Development Branch

As of 9 November 1960, this branch had six people including one officer. It performs research and development on projects as assigned by the Commanding Officer, by Busanda, or by higher authority. It maintains liaison for field testing, training, and implementation of new methods and procedures resulting from research at Bureau levels. Also, the branch coordinates contacts between research personnel under contract and operating personnel.

6. Field Service Branch

This branch, which includes two officers and two civilians, maintains liaison with field activities and with principal fleet and force logistics commands. It assists field activities in the implementation of policies and procedures and in the solution of operating problems. The branch prepares the newsletter, SPCC Comments.

7. Provisioning Coordination Branch

The Provisioning Coordination Branch recommends or assists in the development of the repair parts provisioning policy to be followed in the procurement of H-cog equipment, major components, and end products. It schedules and directs the performance of internal provisioning functions. The branch has two officers and 12 civilians. The civilians are organized into two sections. Nine are in a Control Section and three are in a Coordination Section.

The workloads of primary interest in this analysis are handled only in this branch. All incoming provisioning documents are routed to this branch. The branch sets up and monitors provisioning projects, coordinates provisioning effort within SPCC and between SPCC and other SDCP's, and maintains liaison with contractors and purchasing activities. A detailed diagram showing the workflows in the Provisioning Coordination Branch is presented in the appendix.

B. Labor Costs

1. Workloads

The workload variables and constants that are pertinent for the System Planning Division, and the branches and sections with which the workloads are associated, are identified below. The correspondence of workloads with branches is, in some cases, somewhat arbitrary, but represents the best judgment of the research team.

Subscript f - Fixed Costs. Personnel at the division level, all Navy officers,, and all personnel in the System Procedures Branch, Program Data Branch, Advanced Logistic Research and Development Branch, and Field Service Branch are treated as fixed. These people perform supervisory and administrative duties and/or perform special studies which are of a staff nature and not directly related to the routine workloads at SPCC. In either case, it is expected that their duties would not be significantly affected by rather substantial changes in the volume of the work currently performed at SPCC. That is, their duties may be considered independent of workloads at SPCC over the range of workloads being considered. Therefore, the costs of these personnel are treated as fixed and are denoted by the subscript, f.

G_h - Provisioning Items, H- cog. The workload of the civilians in the two sections of the Provisioning Coordination Branch varies with the number of H-cog provisioning items handled at SPCC. Therefore, the costs of these personnel are related to the workload variable for provisioning items, G_h.

Subscript nh - Nonpertinent Workloads, H-cog. It is felt that the workload of the civilians in the Industrial Mobilization Branch is variable but is independent of the decision alternatives of interest in this study. Therefore, the costs of these personnel are treated as constant and are denoted by the subscripts, nh.

2. Man-Hours Corresponding to Workloads

The procedures used for associating man-hours with workloads differed for each of the workload variables and constants used for the System Planning Division. The procedures used and the man-hour estimates obtained for each of the workloads are described below.

Subscript f - Fixed Costs. The number of people in the fixed cost category has changed appreciably within the last six months. For example, the Advanced Logistic Research and Development Branch has doubled in size. Accordingly, it is felt that historical man-hour data are of little value in estimating future costs in this category. Rather it was decided to base estimated future costs upon current staffing.

As of 9 November 1960, there were 28 people(including officers) in the categories considered as fixed. It was assumed that each person contributes 1759 "productive" hours per year (see Chapter VIII, Section B, of this report). Thus, it was estimated that fixed labor in the division amounts to 49,252 "productive" man-hours per year.

G_h - Provisioning Items, H-cog. In order to estimate "productive" man-hours expended by personnel to accomplish this workload, the man-month data for the System Planning Division's charges to the provisioning function were converted to man-hours.[1] Thereby, total "productive" man-hours for civilians in the Provisioning Coordination Branch were obtained by month for fiscal year 1960. The data showed an increasing trend during the year.

The measure used for the provisioning workload was the count of provisioning line items.[2] Monthly data on this workload also showed some increasing trend during fiscal year 1960.

Estimated future man-hours associated with provisioning were based upon average "productive" man-hours per provisioning item during fiscal year 1960. During the year 17,268 "productive" man-hours were used and 144,278 provisioning items were processed. Thus, it was estimated that there will be 0.120 "productive" man-hour per provisioning item. The reasons for using average productivity during fiscal year 1960 as the estimate of productivity in this branch are similar to the reasons given for the use of average productivity in the preceding chapter. Again the explicit assumption is that management will act so as to preserve the experienced level of productivity,

Figure XIV-A shows "productive" man-hours of civilians in the Provisioning Coordination Branch plotted against the measure of the provisioning workload by month for fiscal year 1960. The diagonal line represents the estimate of future man-hours as a function of provisioning line items which is used in this analysis.

Subscript nh - Nonpertinent Workloads, H-cog. The man-month data for the System Planning Division's charges to the Industrial Mobilization function were also converted to man-hours.[3] Thereby, it was determined that there were 6,018 such "productive" man-hours during fiscal year 1960. It is felt that this is an appropriate estimate of annual "productive" man-hours of civilians in the Industrial Mobilization Branch.

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1. Based on worksheets of the Budget and Statistics Branch of the Administrative and Management Planning Division.
2. See SPCC Supply Management Reports, Part I, Page 2, Line A21, Fiscal Year 1960. Further details can be found in Chapter IV, Section B.1 of this report.
3. See footnote 1 above.

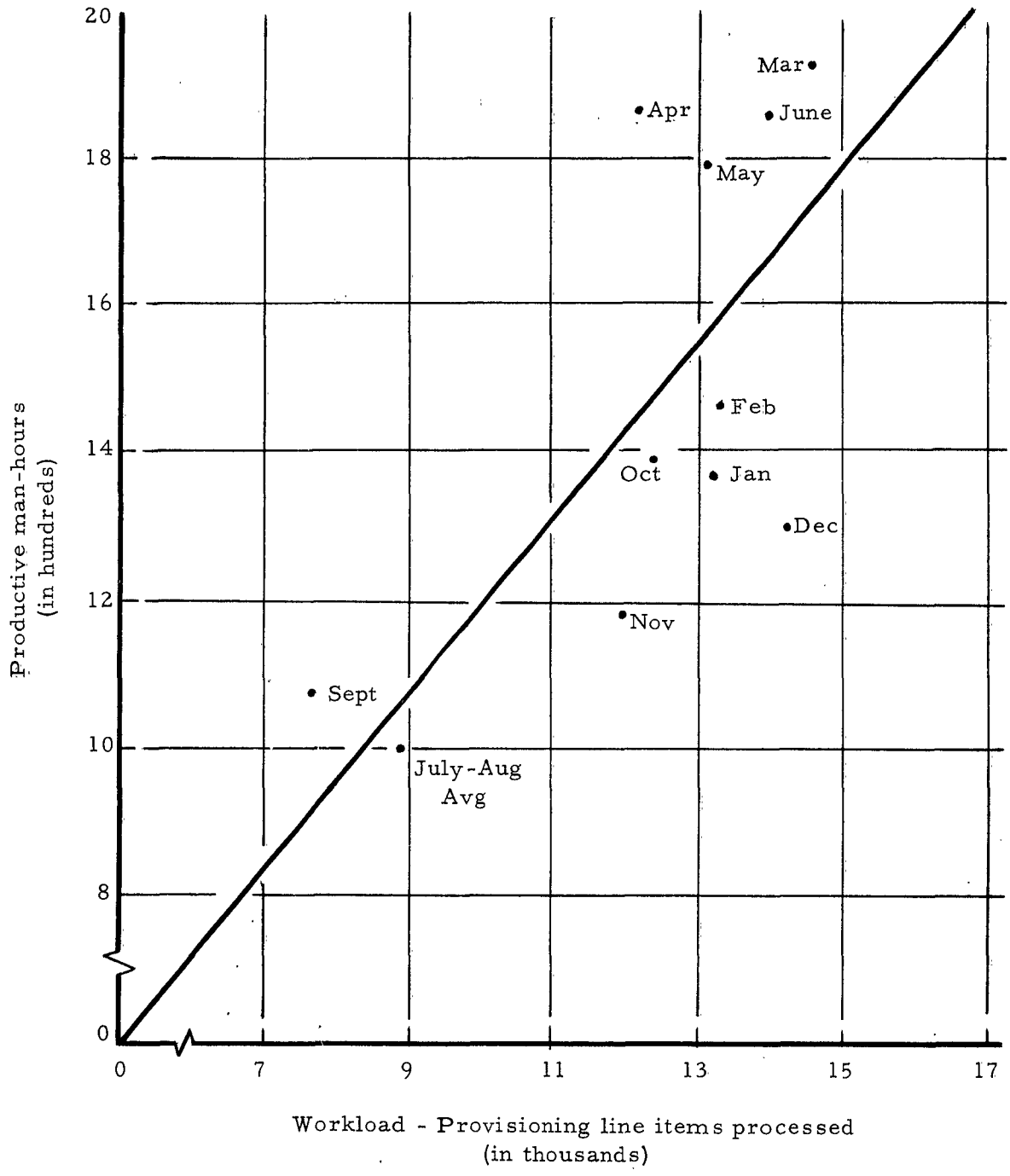

Figure XIV-A Provisioning coordination - productive man-hours vs workload (fiscal year 1960)

3. Labor Costs per Man-Hour

The average labor costs per "productive" man-hour were computed for personnel corresponding to each of the workload variables and constants used for the System Planning Division. The calculations are shown in Table XIV-B. The first column shows the grades of the employees. The second column shows the estimated current average labor cost per "productive" man-hour for each grade. The cost data include allowances for "nonproductive" labor and fringe benefits and were taken from Chapter VIII, Section B, of this report. The remaining columns show the assumed staffing to each workload. The staffing figures were used to obtain a weighted corresponding average of the man-hour labor costs corresponding to each workload.

4. Labor Costs Corresponding to Workloads

The labor cost corresponding to each of the workload variables and constants is the product of the man-hours associated with the workload (shown in Section B.2 of this chapter) and the labor costs per man-hour (shown in Section B.3 of this chapter). The results are summarized in Table XIV-A.

Table XIV-A

Labor costs

	Workloads		
	Constants		Variables
	Subscript f	Subscript nh	G_h
Man-hours			
Per unit of workload			0.120
Per year	49,252	6,018	
Avg. cost per man-hour	4.827	3.843	3.188
Total Labor Cost			
Per unit of workload			0.383
Per year	237,739	23,127	

Table XIV-B

Labor costs per "productive" man-hour

Grade	Cost per Man-Hour	Personnel corresponding to workloads[1]		
		Constants		Variables
		Subscript f	Subscript nh	G_h
Cmdr.	$7.33	4		
Lt. Cdr.	5.82	2		
Lt.	4.66	1		
Lt. j.g.	3.42	1		
GS-13	7.11	1		
GS-12	6.09	1		
GS-11	5.24	5		2
GS-10	4.66		1	
GS-9	4.32		1	1
GS-5	3.05	3		1
GS-4	2.72	4		
GS-3	2.55	1	1	8
Total number of persons		23	3	12
Avg. cost per man-hour		$4.827	$3.843	$3.188

(1) Staffing based on SPCC Manpower Listing, SECNAVINST 5320.4, 31 March 1960.

C. Cost Models

1. General

The cost models in this chapter include only labor costs. The costs of printed forms, paper, etc., consumed in the System Planning Division are not significant. No machine rental costs are incurred in this division.

2. Short-Run Costs

All labor costs are treated as fixed in the short run. The estimated labor costs in the System Planning Division, at current annual rates, are the sum of the costs corresponding to the workloads denoted by the subscripts, f and nh, and by the symbol, G_h. The costs corresponding to the first and second workloads are shown in Section B.4 of this chapter. The costs corresponding to the workload variable, G_h, are the cost per unit times the number of units processed during fiscal year 1960, or \$55,258. The short-run cost model, as thereby obtained, is:

$$T_s = 316,124_f$$

where T_s = total short-run annual dollar costs treated in this chapter.

3. Long-Run Costs

The estimated long-run labor costs for the System Planning Division are as summarized in Section B.4 of this chapter. The cost equation is:

$$T_l = 0.383G_h + 23,127_{nh} + 237,739_f$$

where T_l = total long-run annual dollar costs treated in this chapter, and where the other symbols are as shown in the list given at the front of this volume.

XV. ALLOWANCE AND PUBLICATIONS DIVISION

A. Description

1. General

The Allowance and Publications Division employs 218 people and is responsible for preparing, maintaining and distributing Shipboard Allowance Lists (SAL's) and Coordinated Shipboard Allowance Lists (COSAL's) for Bushipsand Subarpso, for maintaining and distributing Revised Individual and Type Allowance Lists (RIAL's) and (TAL's) for Buships and Budocks, and for distributing Allowance Parts Lists (APL's). The division is also responsible for maintaining the Composite Ship-to-component Record which contains component population and hull application data. A library of SAL's, COSAL's, RIAL's, and TAL's is maintained. Fleet Load and Base Load Lists are developed, prepared, and maintained. In addition, the Allowance and Publications Division maintains the SPCC Technical Library.

The division is composed of four branches. These are the Allowance List Branch, the Load List and Special Allowance List Branch, the Publications Branch, and the Library Branch. A detailed description of the functions of each branch is presented below.

2. Allowance List Branch

This branch, with a staff of 81, prepares and maintains SAL's and COSAL's for Buships and maintains RIAL's and TAL's for Buships and Budocks. It also coordinates action necessary to prepare SAL's and COSAL's for new ships and for Fleet Rehabilitation and Modernization (FRAM) ships. In addition, the branch revises the Ship-to-component and Composite Ship-to-component Records as required.

3. Load List and Special Allowance Programs Branch

This branch, with a staff of 28, develops, maintains and publishes Fleet Issue, Tender, Repair Ship, and Special Mission Load Lists. It also schedules and publishes Base Load Lists for Western Pacific (WESTPAC) bases, coordinates and distributes Subarpso Load Lists, and prepares and publishes shopping guides for customer ships. In addition, the branch prepares Special Allowance Program Listings.

4. Publications Branch

This branch, with a staff of 57, coordinates editorial layout, make-up, illustration, printing and distribution of all sections of the Navy Stock List and allied publications of SPCC and Subarpso. It also prepares other data for printing as are necessary. The branch maintains liaison with printers and printing agencies, ensures preparation of all typing for allowance lists, labels, forms, records and reports, and provides typing service for the division.

In addition, the branch coordinates assembly and distribution of allowance lists and changes thereto, and maintains records of published Allowance Parts Lists.

5. Library Branch

This branch, with a staff of 42, maintains a complete, current technical reference library including engineering drawing data, manufacturer's instruction books, allowance lists, and technical manuals for SPCC and Subarpso.

Presently, it directs and controls the SPCC Microfilm Program for conversion of engineering drawing data to microfilm cards. It also provides assistance to customers in securing technical data and establishes and maintains index, charge-out, and maintenance systems for library material.

6. Division Director's Staff

In addition to the four branches, the division director has a staff of nine, including six civilians, one officer, and two chiefs. In this analysis the division director's staff and each of the branch staffs are considered fixed.

7. Work Flows

None of the work flows of primary interest in this study (i.e., R.R.'s, requisition, provisioning items) are handled by the Allowance and Publications Division.

B. Labor Costs

1. Workloads

Only three of the categories of workloads considered in this report exist in the Allowance and Publications Division. These are fixed workloads, nonpertinent workloads, and workloads proportional to the size of the stock list.

All of the work associated with the production of allowance lists, load lists, and related tasks are considered nonpertinent workloads. That is, they are not relevant to the decisions of interest in this study.[1] However, the production of the Navy Stock List is considered relevant since, as has been stated previously, the size of the stock list is considered one of the alternatives about which it is reasonable to assume decisions will be made. A specific workload symbol, M, is used in this study to denote the workloads which are proportional to the size of the stock lists.

The costs of administrative people are treated as fixed in this analysis. In the Allowance and Publications Division this includes six civilians and four military personnel at the division staff level, and eight civilians at the branch level. In addition, the staff of the library, consisting of some 42 employees, is considered fixed. The library provides support to the Technical and Allowance and Publications Divisions, but its workload is not a direct function of the workloads of either of these divisions. Its workload is considered independent of the actions of these divisions, at least over the range of workloads considered in this study and, therefore, is treated as fixed.

2. Man-Hours

For the most part, the man-hour assignments to the Allowance and Publications Division were based on current staffing rather than historical records since considerable organization changes and revision took place during fiscal year 1960, making historical data of little value. Table XV-A,

1 The nonpertinent workloads associated with allowance lists are denoted by the subscript a, or nonpertinent allowance. The distinction is made to allowance as opposed to general nonpertinent, which is denoted by the subscript n, because of the large size of the allowance workload, and because such costs may be pertinent for certain classes of decisions, which, although not of particular current interest, might be of importance in the future.

shows the man-hour assignments made to the workload categories indicated above during fiscal 1960. Average productivity estimates are also computed.

3. Labor Cost Per Man-Hour

In Table XV-B, a weighted average labor cost per "productive" man-hour is developed for each of the four categories of personnel shown in Table XV-A. These estimates were based on staffing as of March 31, 1960, adjusted to correspond to present staffing and organization.

4. Labor Costs Corresponding to Workloads

The costs per "productive" man-hour developed in Table XV-B were then applied to the relevant man-hours and productivities developed in Table XV-A. This is shown in Table XV-C.

Since all labor costs are fixed in the short-run, the total annual short-run labor cost equals:

$$T_s = 1,255,055_f$$

where T_s = the total annual short-run labor costs in dollars treated in this chapter and where the other symbols are as defined at the beginning of this volume.

The total annual long-run labor cost is:

$$T_l = 0.459M_h + 0.459M_p + 747,845_{ah} + 109,035_{ap} + 316,127_f$$

where T_l = the total annual long-run labor costs in dollars treated in this chapter and where the other symbols are as shown in the list given at the front of this volume.

C. Paper Costs

1. General

The production of Allowance Lists, Navy Stock Lists, Load Lists, and related other products of the Allowance and Publications Division involves considerable costs of paper and printing. For the most part, these costs are incurred in the NSD Mechanicsburg printing operation. Further, the Allowance and Publications Division is the largest consumer of the pro-

Table XV-A

Man-hours, workloads, and productivity

	Division and branch staff	Library staff	Group[1] responsible for Navy stock list		All other personnel	
Man-hours, fiscal 1960	31,662[2]	70,360[3]	31,197		242,742[4]	
			H-cog 23,298[5]	P-cog 7,899[5]	H-cog 211,854	P-cog 30,888[6]
Workloads						
Variables			M_h	M_p		
Constants	Subscript f	Subscript f			Subscript ah	Subscript ap
Measure of workload			133,443[7]	45,257[7]		
Average productivity			5.728	5.728[8]		

(1) This work is accomplished in part of the Publication Section. Man-hour estimates were computed from man-month data obtained from worksheets of the Budget and Statistics Branch of the Administrative and Management Planning Division.

(2) Based on 18 people x 1,759 "productive" man-hours per man-year. For an analysis of the development of this figure see Chapter VIII, Section B.

(footnotes continued on next page)

Table XV-A (Continued)

(3) Based on a staff of 42 less two supervisors, each working at the rate of 1,759 "productive" man-hours per year. (See Chapter VIII, Section B.)

(4) Based on a staff of 214 less 76 in the other three categories, or 138 people, each working at the rate of 1,759 "productive" man-hours per year. (See Chapter VIII, Section B.)

(5) Based on the relative stock list sizes.

(6) Based on Allowance and Publication Division charges to Subarpso obtained from SPCC Supply Management Reports, Form 359, Page 1, April to June 1960, adjusted to annual rates. A trend in the data made this adjustment necessary for predictive purposes.

(7) Number of line items on the stock lists as of 30 September 1960. (See Chapter IV, Section B, of Volume I.

(8) Obtained by dividing the value of the workload variable by man-hours assigned.

Table XV-B

Labor cost per "productive" man-hour

Grade	Cost per man-hour[2]	Staff: Division director and branch staff	Staff: Library	Staff: Stock list group	Staff: All other personnel
Lieutenant Commander	$5.82	2			
Chief Petty Officer	3.55	2			
GS-13	7.11	1			
GS-12	6.09	2			
GS-11	5.24	3			6
GS-10	4.66				2
GS- 9	4.32	2			40
GS- 7	3.66		1	1	35
GS- 6	3.34				2
GS- 5	3.05	1	3		8
GS- 4	2.72		2	5	3
GS- 3	2.55	5	13	9	39
GS- 2	2.39		20	3	3
GS- 1	2.20		1		
Total personnel[1]		18	40	18	138
Average cost per "productive" man-hour		$4.34	$2.54	$2.63	$3.53

(1) Staffing based on SPCC Manpower Listing, SECNAVINST, 5320.4, 31 March 1960; adjusted to organizational breakdown shown.

(2) For a complete discussion of the development of these figures, see Chapter VIII, Section B.

Table XV-C

Labor costs associated with workloads

	Variables		Workloads				Total
	M_h	M_p	Subscript f (Staff)	Subscript f (Library)	Subscript ah	Subscript ap	
Man-hours, fiscal year 1960[1]	23,298	7,899	31,662	70,360	211,854	30,888	
Average productivity[1]	5.73	5.73	-	-	-	-	
Average cost per man-hour[2]	$2.63	$2.63	$4.34	$2.54	$3.53	$3.53	
Average unit cost	$0.459	$0.459	-	-	-	-	
Total annual cost[3]	$61,274	$20,774	$137,413	$178,714	$747,845	$109,035	$1,255,055

(1) Obtained from Table XV-A.

(2) Obtained from Table XV-B.

(3) Obtained by dividing average cost per man-hour by average productivity.

ducts of the NSD Mechanicsburg printing operation. For this reason, an analysis of the NSD Mechanicsburg printing operation will be treated in this section of the report.

2. NSD Mechanicsburg Printing Plant Costs

Table XV-D shows the costs of operating the NSD printing plant and those costs applicable to SPCC. Of the costs applicable to SPCC, a breakdown is shown by division, namely, Purchase, Administrative and Management Planning, and Allowance and Publications.

The costs of printing and paper for the Purchase Division have been computed in Chapter XIII since they are most easily handled on a unit basis (see Footnote (4), Table XV-D). The costs of all miscellaneous printed forms and paper are treated in the analysis of the Administrative and Management Planning Division (Chapter XVI, Section C). On the basis of Printing and Plant estimates, a proportionate amount of SPCC charges was made to Allowance and Publications (see Footnote (6), Table XV-D).

In general, the costs of printing and paper were considered partly fixed and partly variable, both in the short run and the long run, because NSD Mechanicsburg costs include some elements of labor and equipment costs. From Table XV-D total printing and paper costs applicable to the Allowance and Publications Division are $267,783. Of this, $134,578 are fixed in the short run.

3. Paper Costs Corresponding to Workloads

The paper costs which have been discussed were the costs of producing documents associated with allowance list functions (SAL's, COSAL's, RIAL's, etc). These costs were considered to be a function of the non-pertinent allowance list workloads for H and P-cog and, therefore, were denoted by the subscripts, ah and ap.

The proration between these two workloads was based on the labor cost breakdown between the two, obtained from Table XV-C. The relevant costs of paper and printing in the long run are: $233,708$_{ah}$ + $34,075$_{ap}$; and in the short run are: $116,260$_{ah}$ + $16,975$_{ap}$ + $134,578$_{f}$.

Table XV-D

Paper and printing costs

Cost category	Total long-run variable	Short-run fixed	Source
NSD reproduction cost	$520,826	$304,384	(1)
Less: cost not applicable to SPCC	98,957	57,833	(2)
Cost applicable to SPCC	421,869	246,551	
Plus: SPCC contribution to NSD, Mechanicsburg	28,404	-	(3)
Total applicable to SPCC	450,273	246,551	
Less: cost of purchase documents	88,540	48,642	(4)
Total applicable to SPCC except Purchase Division	361,733	197,909	
Plus: cost of outside printing	32,065	-	(5)
Total applicable to SPCC including outside printing	393,798	197,909	
Less total applicable to Allowance and Publications Division	267,783	134,578	(6)
Net treated under Administrative and Management Planning Division	136,015	63,331	(7)

(See following pages for sources.)

Table XV-D (Continued)

(1) Table XV-E shows NSD Mechanicsburg's reproduction department costs for fiscal year 1960. The following costs are considered fixed in the long-run and independent of the decision rules of interest in this analysis: administrative salaries, depreciation of equipment, allowance for space occupied. The net total long-run cost exclusive of the above cost categories is $520,826, on an annual basis.

The following costs are considered fixed in the short run: other salaries, repairs and maintenance, and rental of equipment. The net fixed short-run cost is $304,388 on an annual basis.

(2) An estimate of 19% was provided by the supervisor of the NSD Mechanicsburg reproduction department. This estimate was based on the number of impressions made for SPCC and for others.

(3) This reflects SPCC funds given to NSD Mechanicsburg to cover non-standard reproduction services provided to SPCC. The source of this figure was the Budget and Statistics Branch of the Administrative and Management Planning Division of SPCC. It represents the actual expenditure during fiscal 1960. These costs are not included in line 1.

(4) The total cost of paper used in the Purchase Division, using the unit costs developed in Chapter XIII, Section C, of this volume and the actual number of purchase documents processed during fiscal 1960, amounted to $107,400, of which $48,642 is fixed in the short run. The supervisor of the NSD Mechanicsburg reproduction department estimates, on the basis of the number of employees allocated to producing purchase documents, that 17% of the total effort or $88,540 is expended on these documents. The difference between these two estimates, $18,860, represents the cost of printing done outside of NSD Mechanicsburg.

(5) The total costs of printing done outside of NSD Mechanicsburg, excluding EAM and EDPM printing, amounted to $50,925 during fiscal 1960. This figure was obtained from the Budget and Statistics Branch of the Administrative and Management Planning Division of SPCC. As is noted in footnote (4) above, $18,860 was related to purchase documents. The remaining $32,065 will be prorated on the same basis as NSD Mechanicsburg reproduction costs to the other relevant SPCC functions.

Table XV-D (Continued)

(6) Estimates provided by the supervisor of the NSD Mechanicsburg Reproduction Department indicate that, exclusive of the workload resulting from the Purchase function, about 68% of the department's workload for SPCC results from the preparation of allowance lists (SAL's, COSAL's and RIAL's). Since outside printing costs will be prorated on the same basis, this amounts to 68% of line 9 or $134,578 of short-run fixed costs and $267,783 of total long-run costs.

(7) The remaining $136, 015 of total long-run costs are associated with printing forms, instructions, and notices, reproducing photographs and technical documents, etc., all of which are treated in the analysis of the Administrative and Management Planning Division. Of this, some $63,331 are short-run fixed costs.

Table XV-E

NSD's Reproduction Department costs[1]
(1 January to 30 June 1960)

	Printing and Duplicating Branch	Photographic and Chemical Reproduction Branch	Total times two (i.e., annual rate)
Administrative and supervisory salaries (including annual and sick leave)	$ 7,576.18	$ 4,925.52	$ 25,003.40
All other salaries (including leave)	70,879.86	49,090.40	239,940.52
Cost of paper, chemicals, negatives, plates, etc.	47,079.02	61,142.42	216,442.88
Depreciation of equipment (1% per month of original cost)	3,795.70	1,228.80	10,049.00
Amount spent for repairs and maintenance	1,797.06	3,815.01	11,224.14
Allowance for space occupied, utilities, etc. (at 12.5¢ per month per sq. foot of space)	8,100.00	4,200.00	24,600.00
Rental of equipment (all Xerox equipment)	3,210.00	23,400.00	53,220.00
Total Cost	$142,437.82	$147,802.15	$580,479.94

(1) Source - NSD Semi Annual Printing Plant Report -JCP Form No. 1, June 1960.

D. Cost Models

1. General

The cost models presented in this chapter include the costs of labor, printing, and paper in the Allowance and Publications Division. No machine rental costs are incurred in this division.

2. Short-Run Costs

All labor costs are treated as fixed in the short-run. From Table XV-C these amount to $1,255,055. Thus the short-run dollar cost model, including paper costs is:

$$T_s = 116,260_{ah} + 16,945_{ap} + 1,389,633_f$$

where T_s = the total short-run annual dollar costs treated in this chapter and where the other symbols are as shown in the list given in the front of this volume.

3. Long-Run Costs

Labor costs, as well as printing and paper costs, are treated as variable in the long run. The long-run labor costs are as shown in Table XV-C. Thus, the long-run dollar cost model, including paper costs, is:

$$T_l = 0.459M_h + 0.459M_p + 981,553_{ah} + 143,110_{ap} + 316,127_f$$

where T_l = the total long-run annual dollar costs treated in this chapter and where the other symbols are as shown in the list given in the front of this volume.

XVI. ADMINISTRATIVE AND MANAGEMENT PLANNING DIVISION

A. Description

1. General

The Administrative and Management Planning Division acts in the capacity of a staff to the commanding officer. Its major functions include preparation and maintenance of structural and functional organization charts, analysis of SPCC operations and procedures, review and coordination of SPCC instructions and notices, review of SPCC financial operations, coordination of industrial relation matters, routing and control of incoming correspondence, conduct of special studies, and other duties. As of 9 November 1960, the division had one Naval officer and 55 civilian employees. The civilians are organized into three branches, Management Control, Budget and Statistics, and Correspondence. The functions of each of the branches are briefly described below.

Personnel associated with the Office of the Commanding Officer are included with the Administrative and Management Planning Division in this analysis. There are six such people. They include the Commanding Officer, the Executive Officer, a steward, a small business specialist, and two secretaries.

2. Management Control Branch

The Management Control Branch has 32 civilians. It prepares and maintains SPCC internal instructions and notices, prepares and maintains structural and functional organization charts, administers various management control programs, reviews SPCC position descriptions for organizational alignment, determines requirements for the allocation of space, materials, and equipment for SPCC, conducts special studies, and prepares the magazine, SPCC Center Line. The branch includes four sections, Procedures and Special Projects, Management Review, Management Aids, and Methods Engineering.

3. Budget and Statistics Branch

The Budget and Statistics Branch administers the budget for the maintenance and operation of SPCC, performs statistical analysis, administers the Work Measurement Program, and provides illustrative services to the divisions of SPCC. The branch includes seven civilians. It has three sections, Budget, Statistics, and Illustration.

4. Correspondence Branch

The Correspondence Branch receives, routes, and controls all incoming correspondence, maintains central correspondence files, and provides messenger service for delivery and pick-up of incoming and outgoing correspondence and dispatches for SPCC. The branch has 16 people. It includes three sections, Routing, Files and Follow-Up, and Classified.

B. Labor Costs

1. Man-Hours Corresponding to Workloads

Most of the functions of the Administrative and Management Planning Division are independent of workloads at SPCC over the range of workloads being considered. Labor costs corresponding to such functions are treated as fixed and are denoted by the subscript, f. Clearly, the costs of the Office of the Commanding Officer are fixed (in the sense used in this report). Costs of the Management Control Branch and the Budget and Statistics Branch are also treated as fixed. This is because the functions of these branches are of a staff nature. It is felt that decisions to increase or decrease labor in these branches are determined primarily by factors other than the magnitudes of operating workloads at SPCC.

Labor costs in the Correspondence Branch are considered to vary with the amount of correspondence handled at SPCC. It is felt that a good index of the amount of correspondence handled is total labor costs at SPCC. Therefore, labor costs in the Correspondence Branch are prorated to all of the workloads used in this analysis on the basis of the total SPCC labor costs corresponding to each workload.

The estimated number of man-hours per year which are considered fixed in the Office of the Commanding Officer and in the Administrative and Management Planning Division is based on 46 people (the actual number of people on board as of 9 November 1960), each working at the rate of 1,759 "productive" man-hours per year.[1] Thus, estimated fixed labor amounts to 80,914 "productive" man-hours per year.

1 See Chapter VIII, Section B of this report.

The estimated number of man-hours, at current annual workloads, in the Correspondence Branch, is based on 16 people (the actual number of people on board for the last year or so), each working at the rate of 1,759 "productive" man-hours per year.[1] Thus, estimated labor in this branch amounts to 28,144 man-hours per year.

2. Labor Costs Corresponding to Workloads

Average labor costs per "productive" man-hour were calculated separately for personnel treated as fixed and for personnel in the Correspondence Branch. The calculations are shown in Table XVI-A. The costs per "productive" man-hour for each grade include allowances for "non-productive" labor and fringe benefits.[2] The staffing figures, which were used as weights to obtain average labor costs per man-hour, were as of 31 March 1960.

The estimated total annual labor cost for personnel treated as fixed is the estimated number of "productive" man-hours per year times the average labor cost per "productive" man-hour. Thus, it amounts to 80,914 x $4.143, or $335,227 per year. The estimated labor cost in the Correspondence Branch, at current annual rates, is calculated in a similar manner and amounts to 28,144 x $2.514, or $70,754.

As was stated previously, labor costs in the Correspondence Branch are considered to be directly proportional to total labor costs at SPCC. Total labor costs at SPCC, at current annual rates, are the sum of the short-run labor costs for each division, as shown in Chapters IX through XVI of this report. These costs are summarized in Table XVI-B.

Thus, total labor costs at current annual rates at SPCC, excluding the Correspondence Branch, are $9,001,017. The Correspondence Branch increases this by $70,754, or by 0.786 per cent. Since labor costs in the Correspondence Branch vary with total labor costs at SPCC, the Correspondence Branch increases the labor costs corresponding to each of the workloads used in this analysis by 0.786 per cent. The labor costs associated with each workload are shown in Table XVI-C.

1 Ibid
2 Ibid

Table XVI-A

Labor costs per "productive" man-hour

Grade	Cost per "productive" man-hour	Staffing(1) Treated as fixed	Staffing(1) Correspondence Branch
Captain	$9.23	2	
Commander	7.33	1	
Petty Officer, 1st Class	3.00	1	
GS-13	7.11	1	
GS-12	6.09	2	
GS-11	5.24	11	
GS-9	4.32	5	
GS-7	3.66	6	
GS-6	3.34	2	1
GS-5	3.05	4	
GS-4	2.72	8	5
GS-3	2.55	3	4
GS-2	2.39	4	2
GS-1	2.20	-	4
Total personnel		50	16
Average cost per man-hour		$4.143	$2.545

(1) Based on SPCC Manpower Listing, SECNAVINST 5320.4, 31 March 1960.

Table XVI-B

SPCC labor costs

Division	Labor costs at current annual rates
Stock Control	$1,100,246
Data Processing	1,228,605
Technical	3,805,830
Financial Control	145,324
Purchase	814,606
System Planning	316,124
Allowance and Publications	1,255,055
Administrative and Management Planning	405,981
Total	$9,071,771
Less: Correspondence Branch	70,754
Net	$9,001,017

Table XVI-C

Costs corresponding to workloads

Workload[1]	Total labor cost[2] corresponding to workload	Labor cost in[3] Correspondence Branch	Paper cost in[4] Adm. & Mgmt. Planning Division	
Variables (Costs per unit)			Short-run	Long-run
A_h	$ 0.496	$ .004	$ .003	$ .007
A_p	0.237	.002	.002	.004
B_h	0.613	.005	.004	.009
C_h	14.62	.115	.103	.221
C_p	13.28	.104	.093	.201
D_h	4.89	.038	.034	.074
E_h	1.77	.014	.012	.027
E_p	10.06	.079	.071	.152
F_h	.72	.006	.005	.011
F_p	9.01	.071	.063	.136
G_h	4.481	.035	.032	.068
G_p	1.126	.009	.008	.017
H_h	7.35	.058	.052	.111
H_p	7.35	.058	.052	.111
J_h	12.55	.099	.088	.190
J_p	12.55	.099	.088	.190
K_h	42.30	.332	.298	.639
K_p	42.30	.332	.298	.639
L_h	58.09	.457	.409	.878
L_p	58.09	.457	.409	.878
M_h	66.55	.052	.047	.101
M_p	2.614	.021	.018	.039
Constants (Costs per year)				
Subscript ah	$1,687,390	$13,263	$11,879	$25,496
Subscript ap	140,465	1,104	989	2,122
Subscript nh	904,541	7,101	6,368	13,668
Subscript np	14,289	112	101	216
Subscript nm	203,384	1,599	1,432	3,073
Subscript f	1,704,933	13,400	75,334	25,762

(See footnotes on next page)

Table XVI-C (Continued)

(1) Workload symbols are as defined at the beginning of this volume.

(2) Sum of the total long-run labor costs associated with each workload as developed in Chapters IX through XVI of this report. Excludes labor in the Correspondence Branch.

(3) Long-run costs; 0.786 of column 2; see text for rationale.

(4) Long-run costs; 1.511% of column 2; short-run costs: 0.704% of column 2, plus $\$63,331_f$. See text for rationale.

C. Paper Costs

The paper costs considered in this analysis of the Administrative and Management Planning Division include the costs of all paper, forms, and printing services which are not specifically treated in the analyses of paper costs in the other divisions. Thus, it includes all paper costs except those associated with workloads in the Data Processing Division, Purchase Division, and Allowance and Publications Division. The total amount of such costs during fiscal year 1960 was estimated in Chapter XV, Section C, as being $136,015 of which $66,884 are fixed in the short run (see Table XV-D, line 11).

Paper included in this analysis consists primarily of SPCC instructions, notices, and memoranda, various types of printed forms, and other miscellaneous items. Some of these items are directly related to the workload variables and constants used in this report, and some are indirectly related to these workloads. It is believed (and is assumed in this analysis) that, in aggregate, the costs of these items are related to the selected workloads in approximately the same ratios as long-run labor costs.

As shown in Section B of this chapter, labor costs at SPCC, excluding the Correspondence Branch, at current annual rates, amount to $9,008,320. Paper costs associated with the Administrative and Management Planning Division amount to $136,015 in the long run of which $63,331 is fixed in the short run. Therefore, paper costs amount to 1.511 per cent of current labor costs in the long run, and the variable component of paper costs amounts to 0.704 per cent of current labor costs in the short run. The allocation of paper costs to specific workloads is shown in Table XVI-C.[1]

D. Cost Models

1. General

The cost models in this chapter include labor costs and paper costs. No machine rental costs are incurred in the Administrative and Management Planning Division.

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1 Total labor costs at SPCC are understated by the cost of labor in the Correspondence Branch. The ratio of paper costs to labor costs is overstated correspondingly. However, since labor costs in the Correspondence Branch are prorated to workloads in the same manner as paper costs, no error results from employing this simple manipulation.

2. Short-Run Costs

In the short run all labor costs are treated as fixed and are denoted by the subscript, f. Total labor costs at current annual rates in the division (including the Office of the Commanding Officer) were developed in Section B of this chapter. They amount to $405,981. Paper costs in the division are as shown in Table XVI-C. Thus the short-run cost model is:

$$T_s = .003A_h + .002A_p + .004B_h + 0.10C_h + 0.09C_p + 0.034D_h$$
$$+ 0.01E_h + 0.07E_p + 0.01F_h + 0.07F_p + 0.032G_h + 0.008G_p$$
$$+ 0.05(H_h + H_p) + 0.09(J_h + J_p) + 0.30(K_h + K_p) + 0.41(L_h + L_p)$$
$$+ 0.047M_h + 0.018M_p + 11,879_{ah} + .989_{ap} + 6,368_{nh} + 101_{np}$$
$$+ 1,432_{nm} + 481,132_f$$

where T_s = total short-run annual dollar costs treated in this chapter and where the other symbols are as shown in the list given in the front of this volume.

3. Long-Run Costs

Labor costs as well as paper costs are treated as variable in the long run. However, as described in Section B of this chapter, all labor costs in the division except those in the Correspondence Branch are denoted by the subscript, f. They amount to $335,227. The remaining labor costs in the division, and all paper costs, are as given in Table XVI-C, (column 3 and column 5). Thus the long-run cost equation is:

$$T_l = 0.011A_h + .006A_p + 0.014B_h + 0.34C_h + 0.31C_p + 0.112D_h$$
$$+ 0.04E_h + 0.23E_p + 0.02F_h + 0.21F_p + 0.103G_h + .026G_p$$
$$+ 0.17 (H_h + H_p) + 0.29 (J_h + J_p) + 0.97 (K_h + K_p)$$
$$+ 1.34 (L_h + L_p) + 0.153M_h + 0.060M_p + 38,759_{ah} + 3,226_{ap}$$
$$+ 20,769_{nh} + 328_{np} + 4,672_{nm} + 374,389_f$$

where T_l = total long-run annual dollar costs treated in this chapter and where the other symbols are as shown in the list given in the front of this volume.

XVII. OTHER COSTS

A. General

This chapter deals with several cost categories not treated in the other sections of this report. These cost categories are (1) capital costs of land, buildings, and major equipments, (2) costs of services provided by NSD Mechanicsburg to SPCC, and (3) SPCC expenditures for miscellaneous items. Each of these cost categories will be treated in a separate section, and the total costs will be summarized at the end of the chapter.

B. Capital Costs

Capital costs as defined in this report include the costs of the land, buildings, and major equipment used by SPCC. These costs are treated as fixed costs since they are independent of workloads over the range of operations considered in this study. The annual cost of capital, as the term is used in this study, refers to the annual interest charges on an amount of capital equivalent to the present value of the facilities plus an estimate of the amount of capital lost through actual physical depreciation of the asset. The annual interest charge is assumed to be 4.5%. The depreciation charge is a function of the particular type of asset being considered.

Estimates of present value and annual depreciation charges for the various classes of capital assets were derived as follows:

1. Land

NSD Mechanicsburg occupies 841 acres, which were acquired between 6 July 1942 and 2 April 1943 at a cost of $158,988.69. It is estimated, on the basis of current land values in the Mechanicsburg area, that the present market value of the land is about $500,000. Since SPCC occupies about 2 percent of this land, the present value of the land occupied by SPCC is about $10,000.

2. Buildings

The original cost of the buildings at SPCC, which were erected in 1943 and 1944, were:

SPCC Administration Building	$ 507,285
SPCC Technical Building	586,136
SPCC Cafeteria	134,764
Boiler House (assuming 8/13ths of cost pertains to SPCC)[1]	41,853
Total Buildings	$1,270,038

Adjusted to current prices using the Engineering News-Record, Index of Building Construction Costs, this figure becomes $3,105,000. Further, it is estimated that the buildings have a useful life of 50 years, some 17 of which have gone by. Therefore, the actual current value of the buildings is $2,049,300. Based on a life expectancy of 33 more years, the annual charges necessary to recoup dissipated capital as a result of physical depreciation of the assets equals $62,100.

3. Equipment

Investment in equipment, stated at acquisition cost, is $271,013. It is estimated that the equipment has an average useful life of ten years and that the present value of the equipment is half its acquisition value or $135,507. Further, the average depreciation charge is 10% of the acquisition cost, or $27,100.

4. Summary

The present value of all capital assets is estimated to be $2,194,800. At 4.5%, the total interest charge on the capital is $53,316. The total annual depreciation charges on buildings and equipment is estimated to be $89,200. Since both interest and depreciation on capital assets are considered to be fixed, both in the short run and in the long run, the functional relationships describing capital costs are:

$$T_s = T_l = 142,516_f$$

where

T_s = total short-run annual capital costs, in dollars.

T_l = total long-run annual capital costs, in dollars.

[1] This is the ratio of SPCC area to total area served by the facility.

C. Services Provided by NSD Mechanicsburg

SPCC is a tenant of the Naval Supply Depot at Mechanicsburg. Many of the service functions normally associated with operating a base are provided without charge to SPCC by NSD Mechanicsburg. The costs of these services are included in the cost models for SPCC to the extent that the costs would not be incurred if no services were supplied to SPCC. Table XVII-A shows the estimated costs of these services and how the estimates were derived.

All of the costs shown in Table XVII-A are assumed to be fixed in the short run. In the long run, the costs fall into two categories:

1. Costs that are assumed to be independent of SPCC workloads over the range of workloads being considered in this report. (However, they would not be incurred if SPCC were to close down.) They include such items as security, building maintenance, fuel, etc. Such costs are treated as fixed and are denoted by the subscript, f. They amount to an estimated $147,171 per year.

2. Costs that are considered to be variable with total labor costs at SPCC. They include such items as industrial relations, fiscal accounting, supply support, etc. They amount to an estimated $296,089 per year. This is 3.264% of estimated total labor costs at SPCC at current annual rates (see Chapter XVI, Section B.2).

SPCC also provides services to NSD Mechanicsburg. These consist of fiscal accounting services performed by the Data Processing Division. In this report the cost of these services is denoted by the subscript, nm. However, as explained in footnote (6) of Table XVII-A, an estimated $69,162 per year of these costs result from the services necessary to support SPCC activities. Therefore, these costs should be charged not to NSD Mechanicsburg but to SPCC, and in the long-run cost model of this chapter, this amount is deducted from the costs denoted by the subscript, nm, and is included in the costs which are prorated to all SPCC workloads on the basis of the total labor.

The cost models for services provided by NSD Mechanicsburg, as derived from Table XVII-A, are:

Table XVII-A

Cost of services provided by NSD Mechanicsburg
(Annual rates)

	Number of people in department[1]	Cost of variable personnel[2]	Percent allocated to SPCC[1]	Cost allocated to SPCC		
				Short run	Long run: Fixed	Long run: Variable with SPCC labor
Labor costs by department						
Industrial relations	42	$215,140	27.3	$ 58,733	$ -	$ 58,733
Medical	12	61,469	27.0	16,597	-	16,597
Fiscal	36	184,406	23.0	42,413	-	42,413
Supply support	23	117,815	32.5	38,290	-	38,290
Reproduction[3]	-	-	-	-	-	-
Mail	13	66,591	24.0	15,982	-	15,982
Switchboard	5	25,612	56.0	14,343	-	14,343
NTX	10	51,224	63.0	32,271	-	32,271
Transportation	27	138,305	6.0	8,298	-	8,298
Security	2	10,245	34.0	3,483	3,483	-
Public works	175	896,418	11.2	100,399	100,399	-
Other costs						
Fuel[4]				13,266	13,266	-
Electricity[4]				20,431	20,431	-
Water[4]				3,592	3,592	-
Janitorial materials[5]				6,000	6,000	-
Adjustment for services provided by SPCC[6]				-	-	69,162
Total				$374,098	$147,171	$296,089

(See footnotes on next page.)

Table XVII-A (continued)

(1) From Recapitulations of Common Service Effort by Functional Area, a report prepared by NSD Mechanicsburg in April 1960.

(2) The average wage at NSD Mechanicsburg is $2.518 per hour. From Chapter VIII, Section B, there are 2,087 paid (productive and nonproductive) hours per year. Also fringe benefits equal 7.117% of total wages. Therefore, average annual labor costs per employee are $2.518 x 2.087 x 1.07117 = $5,629. However, analysis of operating divisions in SPCC, such as Technical, Financial Control, Data Processing, and Stock Control, indicated that about 9% of the total civilian labor cost is fixed over the range of workloads of interest. The remaining 91% is variable. Accordingly, the annual cost of variable personnel is equal to the number of people in the department times $5,629 times 0.91.

(3) Reproduction costs are omitted from this chapter since they were included in the sections of the preceding chapters which deal with paper costs. In particular, see Chapter XV, Section D.2.

(4) Actual costs for fiscal year 1959 as shown on records maintained by Public Works Department.

(5) Cost estimate of Public Works Department for fiscal year 1961.

(6) Total long-run costs denoted by the subscript, nm, as developed in Chapters IX through XVI of this report, amount to $300,708 per year. This represents the cost of services provided by SPCC to NSD Mechanicsburg's Fiscal Department. However, it is estimated that 23% of this, or $69,162 represents services which are incurred as a result of SPCC activities and which vary with total labor costs at SPCC. Accordingly, in this chapter the $69,162 is deducted from the costs denoted by the subscript, nm, and prorated back to all SPCC workloads on the basis of total labor at SPCC.

$$T_s = 374,098_f$$
$$T_l = 0.03264R - 69,162_{nm} + 147,171_f$$

where

T_s = total short-run annual dollar cost of services provided by NSD Mechanicsburg
T_l = total long-run annual dollar cost of services provided by NSD Mechanicsburg
R = total annual labor costs at SPCC

and where the other symbols are as shown in the list given in the front of this volume.

D. Miscellaneous SPCC Expenditures

SPCC has certain minor expenses (henceforth called "miscellaneous SPCC expenditures") which have not been included in any of the preceding portions of this report. These costs are shown in Table XVII-B. They amount to an estimated $248,618 per year. All of these costs are considered as being fixed in the short run. In the long run $80,767 are considered to be independent of workloads over the range of workloads considered in this report and, therefore, are denoted by the subscript, f. The remaining $167,851 are considered to be variable with total labor costs at SPCC. They amount to 1.850% of estimated total labor costs at SPCC at current annual rates.

The rationale for the particular division of long-run costs between fixed and variable was based on an analysis of each cost category to determine how it might behave under changing conditions. Consider, as an example, travel and per diem. At the first glance, it might be assumed that these vary directly with personnel levels. However, more careful analysis turns up the fact that traveling is done mainly by supervisory personnel who are treated as fixed.

The cost models for miscellaneous SPCC expenditures are:

$$T_s = 248,618_f$$
$$T_l = 0.01850R + 80,767_f$$

where

Table XVII-B

Miscellaneous SPCC expenditures

	Fixed	Proportional to total labor
Office supplies (form 989)		$ 41,773
NSD Mechanicsburg for maintenance materials	$ 2,150	
Miscellaneous supplies		43,177
Travel and per diem	71,453	
Telephone		53,771
Teletypewriter		5,709
Wire transmission system	7,164	
Repair of office machines and equipment		12,558
Minor property		10,863
	$80,767	$167,851

Source: Figures for travel and per diem and for minor property were obtained from the monthly SPCC Supply Management Reports, Part II, Fiscal Year 1960. Other figures were obtained from records kept by the Budget and Statistics Branch of the Administrative and Management Planning Division.

T_s = total short-run annual dollar costs of miscellaneous SPCC expenditures

T_l = total long-run annual dollar costs of miscellaneous SPCC expenditures

R = total annual labor costs at SPCC

E. Cost Models

1. Short-Run Costs

The short-run cost model for all costs treated in this chapter is the sum of the three short-run cost models given in Sections B, C, and D. It is:

$$T_s = 765,232_f$$

where

T_s = total short-run annual dollar costs treated in this chapter and where the subscript, f, denotes fixed costs.

2. Long-Run Costs

The long-run cost model for all costs treated in this chapter is the sum of the cost models given in Section B, C, and D. It is:

$$T_l = 0.05114R - 69,161_{nm} + 370,454_f$$

where

T_l = total long-run annual dollar costs treated in this chapter and where the other symbols are as defined in the preceding sections of this chapter.

The variable, R, in the above expression represents total annual labor costs at SPCC. However, the correspondence between labor costs at SPCC and workloads has been detailed in Chapters IX through XVI of this report. Therefore, the costs corresponding to R may be prorated to all SPCC workloads. This is shown in Table XVII-C, where the coefficient of R (0.05114) is applied to the long-run labor costs corresponding to each of the workloads. The complete long-run cost model for the costs treated in this chapter thus becomes:

Table XVII-C

Long-run variable costs corresponding to workloads

Workload	Total labor costs[1]	Long-run variable costs treated in this chapter[2]
Variables (Costs/unit)		
A_h	$0.500	$0.026
A_p	0.239	0.012
B_h	0.618	0.032
C_h	14.74	0.75
C_p	13.38	0.68
D_h	4.93	0.252
E_h	1.78	0.09
E_p	10.14	0.52
F_h	0.73	0.04
F_p	9.08	0.46
G_h	4.52	0.231
G_p	1.14	0.058
H_h	7.41	0.38
H_p	7.41	0.38
J_h	12.65	0.65
J_p	12.65	0.65
K_h	42.63	2.18
K_p	42.63	2.18
L_h	58.55	2.99
L_p	58.55	2.99
M_h	6.71	0.343
M_p	2.64	0.135
Constants (Costs/year)		
subscript ah	1,700,653	86,971
subscript ap	141,569	7,240
subscript nh	911,642	46,621
subscript np	14,401	736
subscript nm	204,983	10,483
subscript f	1,718,333	87,876

(1) Sum of long-run labor costs developed in Chapters IX through XVI.
(2) 5.11% of Column 2.

$$T_l = 0.026A_h + 0.012A_p + 0.032B_h + 0.75C_h + 0.68C_p + 0.252D_h$$
$$+ 0.09E_h + 0.52E_p + 0.04F_h + 0.46F_p + 0.231G_h + 0.058G_p$$
$$+ 0.38H_h + 0.38H_p + 0.65J_h + 0.65J_p + 2.18K_h + 2.18K_p$$
$$+ 2.99L_h + 2.99L_p + 0.343M_h + 0.135M_p + 86,971_{ah} + 7,240_{ap}$$
$$+ 46,621_{nh} + 736_{np} - 58,679_{nm} + 458,330_f$$

where

T_l = the total long-run annual dollar cost treated in this chapter and where the other symbols are as shown in the list given at the front of this volume.

XVIII. SYNTHESIS OF MODELS

A. Dollar Cost Models

1. General

This chapter shows the synthesis of the short-run and long-run dollar cost and elapsed time models developed in the preceding chapters into over-all cost functions for SPCC. The dollar cost models are synthesized in this section, and the elapsed time models are treated in Section B, which follows.

As an aid in understanding this section and in interpreting the data presented herein, the reader is referred to the list of symbols used in the dollar cost models which is given in the front of this volume (pp. vi and vii). A complete discussion of the meanings of each of the terms, as well as values of the variables, is given in Volume I, Chapter IV, Section B.

2. Short-Run Costs

The short run is defined as that period during which the costs of personnel and facilities remain fixed and, therefore, are denoted by the subscript, f. The principal dollar costs that may vary are the costs of machine rentals, and the costs of paper, printed forms, and related supplies. Table XVIII-A shows the short-run dollar cost terms (constants and coefficients of the variables) as developed in Chapter IX through XII of this volume. The complete short-run cost model for SPCC is:

$$T_s = 0.150A_h + 0.638A_p + 0.10C_h + 0.09C_p + 0.034D_h + 0.01E_h$$
$$+ 0.07E_p + 0.01F_h + 0.07F_p + 0.032G_h + 0.008G_p$$
$$+ 1.05\,(H_h + H_p) + 1.09\,(J_h + J_p) + 3.00\,(K_h + K_p)$$
$$+ 8.51\,(L_h + L_p) + 0.787M_h + 1.175M_p + 223,000_{ah}$$
$$+ 39,000_{ap} + 31,000_{nh} + 94,000_{nm} + 10,698,000_f$$

Where T_s = total short-run annual costs in dollars and where the other symbols are as shown in the list given in the front of this volume.

Table XVIII-A

Short-Run Costs

Workload	Chapter IX Stock Control	Chapter X Data Processing	Chapter XI Technical	Chapter XII Financial Control	Chapter XIII Purchase
Variables (costs/unit)					
A_h	$ -	$ 0.147	$ -	$ -	$ -
A_p	-	0.636	-	-	-
B_h	-	-	-	-	-
C_h	-	-	-	-	-
C_p	-	-	-	-	-
D_h	-	-	-	-	-
E_h	-	-	-	-	-
E_p	-	-	-	-	-
F_h	-	-	-	-	-
F_p	-	-	-	-	-
G_h	-	-	-	-	-
G_p	-	-	-	-	-
H_h	-	-	-	-	1.00
H_p	-	-	-	-	1.00
J_h	-	-	-	-	1.00
J_p	-	-	-	-	1.00
K_h	-	-	-	-	2.70
K_p	-	-	-	-	2.70
L_h	-	-	-	-	8.10
L_p	-	-	-	-	8.10
M_h	-	0.740	-	-	-
M_p	-	1.157	-	-	-
Constants (cost/year)					
Subscript ah	-	94,724	-	-	-
Subscript ap	-	20,789	-	-	-
Subscript nh	-	24,190	-	-	-
Subscript np	-	-	-	-	-
Subscript nm	-	92,652	-	-	-
Subscript f	1,100,246	1,831,125	3,805,830	145,324	863,248

Table XVIII-A (Continued)

Workload	Chapter XIV System Planning	Chapter XV Allowance and Pubs.	Chapter XVI Adm. and Mgmt. Plan	Chapter XVII Other Costs	Total
Variables (costs/unit)					
A_h	$ -	$ -	$ .003	$ -	$ 0.150
A_p	-	-	.002	-	0.638
B_h	-	-	.004	-	-
C_h	-	-	0.10	-	0.10
C_p	-	-	0.09	-	0.09
D_h	-	-	0.034	-	0.034
E_h	-	-	0.01	-	0.01
E_p	-	-	0.07	-	0.07
F_h	-	-	0.01	-	0.01
F_p	-	-	0.07	-	0.07
G_h	-	-	0.032	-	0.032
G_p	-	-	0.008	-	0.008
H_h	-	-	0.05	-	1.05
H_p	-	-	0.05	-	1.05
J_h	-	-	0.09	-	1.09
J_p	-	-	0.09	-	1.09
K_h	-	-	0.30	-	3.00
K_p	-	-	0.30	-	3.00
L_h	-	-	0.41	-	8.51
L_p	-	-	0.41	-	8.51
M_h	-	-	0.047	-	0.787
M_p	-	-	0.018	-	1.175
Constants (costs/year)					
Subscript ah	-	116,260	11,879	-	222,863
Subscript ap	-	16,945	989	-	38,723
Subscript nh	-	-	6,368	-	30,558
Subscript np	-	-	101	-	101
Subscript nm	-	-	1,432	-	94,084
Subscript f	316,124	1,389,633	481,132	765,232	10,697,894

3. Long-Run Costs

In the long run all classes of cost are considered as potentially variable. Table XVIII-B shows the long-run dollar cost terms (constants and coefficients of the variables) as developed in Chapters IX through XVII of this volume. The complete long-run cost model for SPCC is:

$$T_l = 0.680A_h + 0.891A_p + 0.659B_h + 15.71C_h + 14.29C_p$$
$$+ 5.175D_h + 1.89E_h + 10.80E_p + 0.78F_h + 9.68F_p$$
$$+ 4.815G_h + 1.210G_p + 9.70 (H_h + H_p) + 15.29 (J_h + J_p)$$
$$+ 50.64 (K_h + K_p) + 77.32 (L_h + L_p) + 7.891M_h + 3.966M_p$$
$$+ 2,142,000_{ah} + 206,000_{ap} + 996,000_{nh} + 15,000_{np}$$
$$+ 242,000_{nm} + 2,805,000_f$$

where T_l = total long-run annual costs in dollars and where the other symbols are as shown in the list given in the front of this volume.

4. Document to Line Item Conversions

Although most of the variables in the above cost functions are measured in line items, the purchase action variables (i.e., H_h, H_p, J_h, J_p, K_h, K_p, L_h, L_p) are measured in documents. There is not a one-to-one correspondence between line items and documents. In using the cost models to evaluate decisions it may, in certain cases, be desirable to convert from documents to line items or vice versa. Factors for making these conversions were presented in Chapter XIII, Section B.3, of this volume. They are repeated below:

Source documents	Purchase documents per line item purchased
NIS Purchase Requisitions ($E_h + E_p$)	0.905
NSI Purchase Requisitions ($F_h + F_p$)	0.586
All Purchase Requisitions	0.673
Replenishment Recommendations ($C_h + C_p$)	0.504
All Purchase Requisitions and R.R.'s	0.579

Table XVIII-B

Long-run costs

Workload	Chapter IX, Stock Control	Chapter X, Data Processing	Chapter XI, Technical	Chapter XII, Financial Control	Chapter XIII Purchase
Variables (cost/unit)					
A_h	$ 0.259	$ 0.384	$ -	$ -	$ -
A_p	-	0.873	-	-	-
B_h	0.613	-	-	-	-
C_h	-	2.28	10.33	2.01	-
C_p	-	2.28	9.01	2.01	-
D_h	2.379	-	2.432	-	-
E_h	-	-	0.72	1.04	-
E_p	-	-	9.01	1.04	-
F_h	-	-	0.72	-	-
F_p	-	-	9.01	-	-
G_h	0.441	.004	3.653	-	-
G_p	-	.004	1.122	-	-
H_h	-	-	-	-	9.15
H_p	-	-	-	-	9.15
J_h	-	-	-	-	14.35
J_p	-	-	-	-	14.35
K_h	-	-	-	-	47.49
K_p	-	-	-	-	47.49
L_h	-	-	-	-	72.99
L_p	-	-	-	-	72.99
M_h	0.315	2.344	4.277	-	-
M_p	-	2.761	0.551	-	-
Constants (costs/year)					
Subscript ah	3,389	231,455	799,425	-	-
Subscript ap	-	52,219	-	-	-
Subscript nh	73,050	109,578	700,813	22,163	-
Subscript np	-	4,539	9,750	-	-
Subscript nm	-	296,036	-	-	-
Subscript f	185,671	728,324	344,483	26,332	133,550

Table XVIII-B (Continued)

Workload	Chapter XIV System Planning	Chapter XV Allowance and Pubs.	Chapter XVI Adm. and Mgmt. Plan	Chapter XVII Other Costs	Total
Variables (Costs/unit)					
Ah	$ -	$ -	$ 0.011	$ 0.026	$ 0.680
Ap	-	-	0.006	0.012	0.891
Bh	-	-	0.014	0.032	0.659
Ch	-	-	0.34	0.75	15.71
Cp	-	-	0.31	0.68	14.29
Dh	-	-	0.112	0.252	5.175
Eh	-	-	0.04	0.09	1.89
Ep	-	-	0.23	0.52	10.80
Fh	-	-	0.02	0.04	0.78
Fp	-	-	0.21	0.46	9.68
Gh	0.383	-	0.103	0.231	4.815
Gp	-	-	0.026	0.058	1.210
Hh	-	-	0.17	0.38	9.70
Hp	-	-	0.17	0.38	9.70
Jh	-	-	0.29	0.65	15.29
Jp	-	-	0.29	0.65	15.29
Kh	-	-	.97	2.18	50.64
Kp	-	-	.97	2.18	50.64
Lh	-	-	1.34	2.99	77.32
Lp	-	-	1.34	2.99	77.32
Mh	-	0.459	0.152	0.343	7.891
Mp	-	0.459	0.060	0.135	3.966
Constants (costs/year)					
Subscript ah	-	981,553	38,759	86,971	2,141,552
Subscript ap	-	143,110	3,226	7,240	205,795
Subscript nh	23,127	-	20,769	46,601	996,121
Subscript np	-	-	325	736	15,353
Subscript nm	-	-	4,672	-58,679	242,029
Subscript f	237,739	316,127	374,389	458,330	2,804,945

B. Elapsed Times

1. General

The term, "elapsed time," as it is used in this report, is the difference between the time that work is received and the time that the work is completed. There are elapsed times associated with each type of work performed in each division at SPCC. However, the only elapsed times analyzed in this report are those associated with the classes of workloads which result in almost all of the H-cog procurement actions at SPCC. These classes are: 1) workloads associated with the replenishment of system stocks, and 2) workloads associated with the processing of passed requisitions. The elapsed times incurred in each division and associated with these classes of work are discussed in the pertinent chapters of this volume. In this section, the relevant elapsed times in each division are added in order to obtain over-all SPCC elapsed times for the two classes of work.

As an aid in understanding the models given in this section, the reader is referred to the list of symbols used in the elapsed time models which is given in the front of this volume (pp. vi and vii). A more complete discussion of the meanings of the variables is given in Volume I, Chapter IV, Section C.3. The estimated "normal" value of each of the variables is given in Chapter V, Section B, of Volume I.

2. Replenishment of System Stocks

Elapsed times associated with the replenishment of system stocks begin when transaction reports from field activities are received at SPCC. The work is completed when purchase orders or contracts are mailed. The components of total SPCC elapsed time are as follows:

a. The time between the receipt of EAM transaction reports from field activities and the cutoff date for such receipts for a supply-demand review. This time is incurred in the Data Processing Division and is discussed in Chapter X, Section F of this volume. Since supply-demand reviews are currently made biweekly, this elapsed time averages 7.0 days and varies from 0.0 day to 14.0 days. This time is represented by the first term of the over-all model, which is given below.

b. The time between the cutoff date for the receipt of transaction reports and the release of verified R.R.'s to the Technical and Financial Control Divisions. This elapsed time is incurred in the Data Processing and

Stock Control Divisions and is also discussed in Chapter X, Section F, of this volume. The average elapsed time is 18.0 days. There is little variation about the average. The time is represented by the second term of the over-all model.

c. The time between the release of R.R.'s to the Technical and Financial Control Divisions and the release of the R.R.'s by the Technical Division to the Purchase Division. This time is incurred concurrently in the Financial Control Division and in the Technical Division. Since the time in Financial Control is very small (see Chapter XII, Section D), only time in the Technical Division need be considered. This is discussed in Chapter XI, Section D, of this volume. The average time for R.R.'s processed by equipment specialists is 13.0 days. The average for R.R.'s not processed by equipment specialists is estimated to be 2.0 days. The over-all average is 7.1 days. There is much variation about this average. This time is represented by the third and fourth terms of the over-all model.

d. The time between the release of R.R.'s by the Technical Division to the Purchase Division and the mailing of purchase orders or contracts. This time is discussed in Chapter XIII, Section E, of this volume. It averages 39.1 days. There is much variation about this average, which is caused principally by differences in type of purchase documents, differences in information (bids and quotes) requested from potential suppliers, and differences in workload levels. These times are represented by the fifth, sixth, seventh, eighth and ninth terms of the over-all model.

The over-all elapsed time for SPCC is the sum of the elapsed times discussed above. The model for stock replenishments is:

$$t_1 = \frac{V_1}{2} + V_2 + 2.0 + 11.0U_2 + (1 - U_3)(3.0 + 11.0^{W_1}) + (1 + U_4 + U_5 + U_6)(2.0 + 6.5^{W_2^2}) + 25.9U_4 + 37.5U_5 + 46.9U_6$$

where t_1 = average elapsed time in calendar days for Stock Replenishments and where the other symbols are as shown in the list given in the front of this volume.

3. Requisitions

Elapsed times associated with the processing of passed requisitions begin when such requisitions are received at SPCC. The work is completed

when redistribution action is taken or (if procurement action is taken) when purchase orders or contracts are mailed. The components of total SPCC elapsed time are as follows:

a. Time between the receipt of passed requisitions in the Stock Control Division and the completion of redistribution action or (if procurement action is taken) the release of the requisitions to the Purchase Division. This time is incurred in the Stock Control and Technical Divisions and is discussed in Chapter IX, Section D, of this volume. If redistribution action is taken, no other elapsed time is incurred at SPCC and the model is given by the first of the equations shown below. The elapsed time averages 2.4 days. If procurement action is taken, additional elapsed time is incurred. This component of the elapsed time averages 3.7 days and is represented by the first term of the second equation given below.

b. Time between the release of purchase requisitions to the Purchase Division and the mailing of purchase orders or contracts. This time is discussed in Chapter XIII, Section E, of this volume. It averages 10.7 days. There is much variation about this average, which is caused principally by differences in types of purchase actions, differences in information requested by potential suppliers, and differences in workload levels. These times are represented by all but the first term in the second equation given below.

The over-all elapsed time models for requisitions are:

For requisitions resulting in redistributions

$$t_3 = 1.8 + 1.9U_1$$

For requisitions resulting in procurements

$$t_2 = 3.7 + (1 - U_7)(0.5 + 4.5^{W_1}) + (1 + U_8 + U_9 + U_{10})(2.0 + 4.2^{W_2^2}) + 25.9U_8 + 37.5U_9 + 46.9U_{10}$$

where t = average elapsed time in calendar days for requisitions and where the other symbols are as shown in the list given in the front of this volume.

APPENDICES

I. FLOW DIAGRAMS

II. LIST OF CONTRACTORS TO SPCC WHO SUPPLIED INFORMATION

APPENDIX I

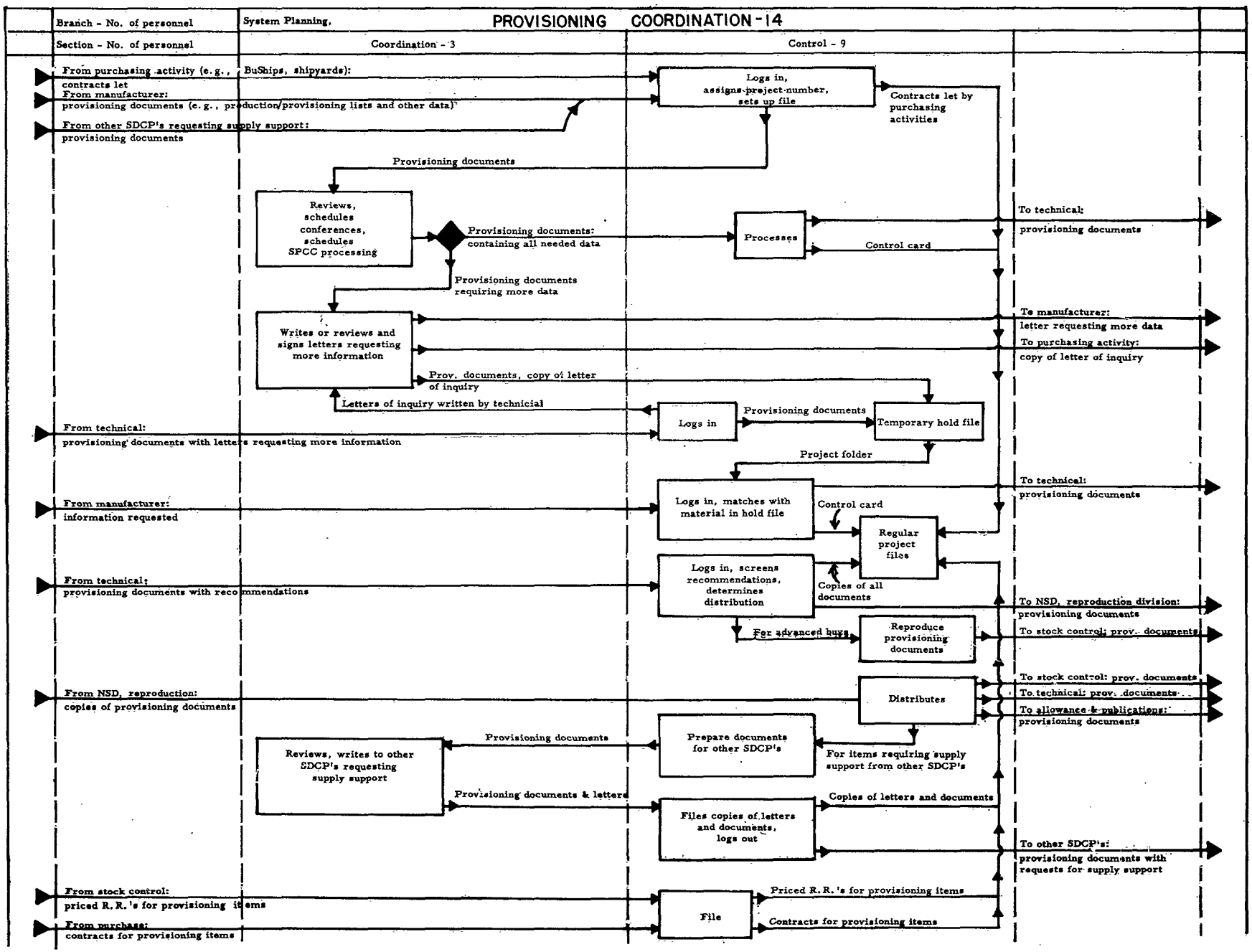
The accompanying flow diagrams show the principal routine flow of information pertaining to procurement at SPCC. The charts are intended to provide generalized information about the flow of information and documents through SPCC. Information not related to procurement as well as burdensome details and exceptions are omitted.

Each flow diagram is divided into vertical strips which correspond to organizational subdivisions (i.e., branch, section, or unit). The diagrams show the inputs and outputs to each subdivision and the work performed in the subdivision. Major functions of a subdivision which are not indicated elsewhere are shown in boxes at the bottom of the diagrams. The numbers beside the name of the subdivision indicate the total number of civilian and military personnel in that subdivision. These numbers were obtained from the official manpower listing as of 31 March 1960.

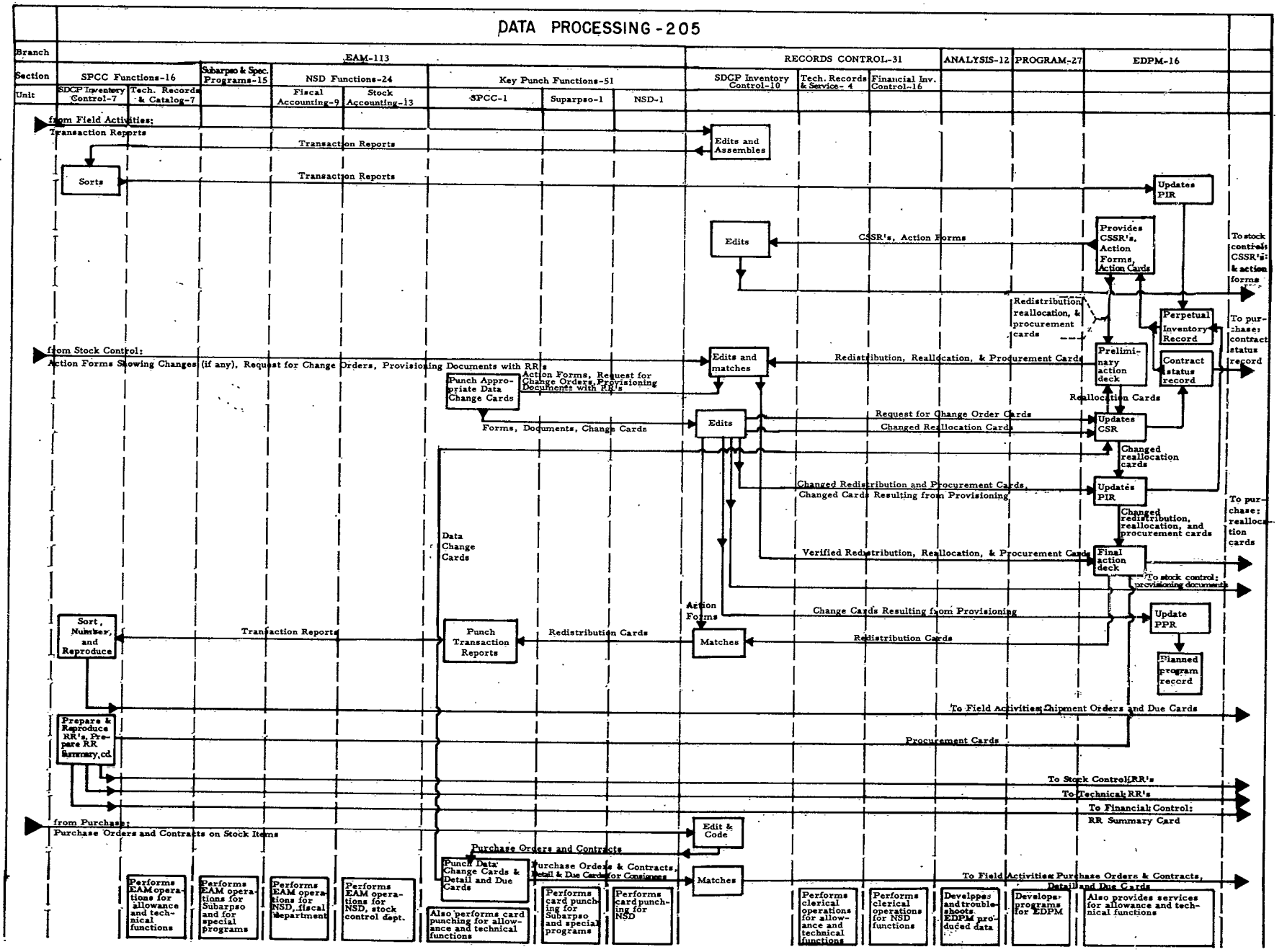
The diagrams were prepared on the basis of information obtained through interviews with the people performing the functions and from SPCC written instructions.

Diagrams for the following divisions are included:

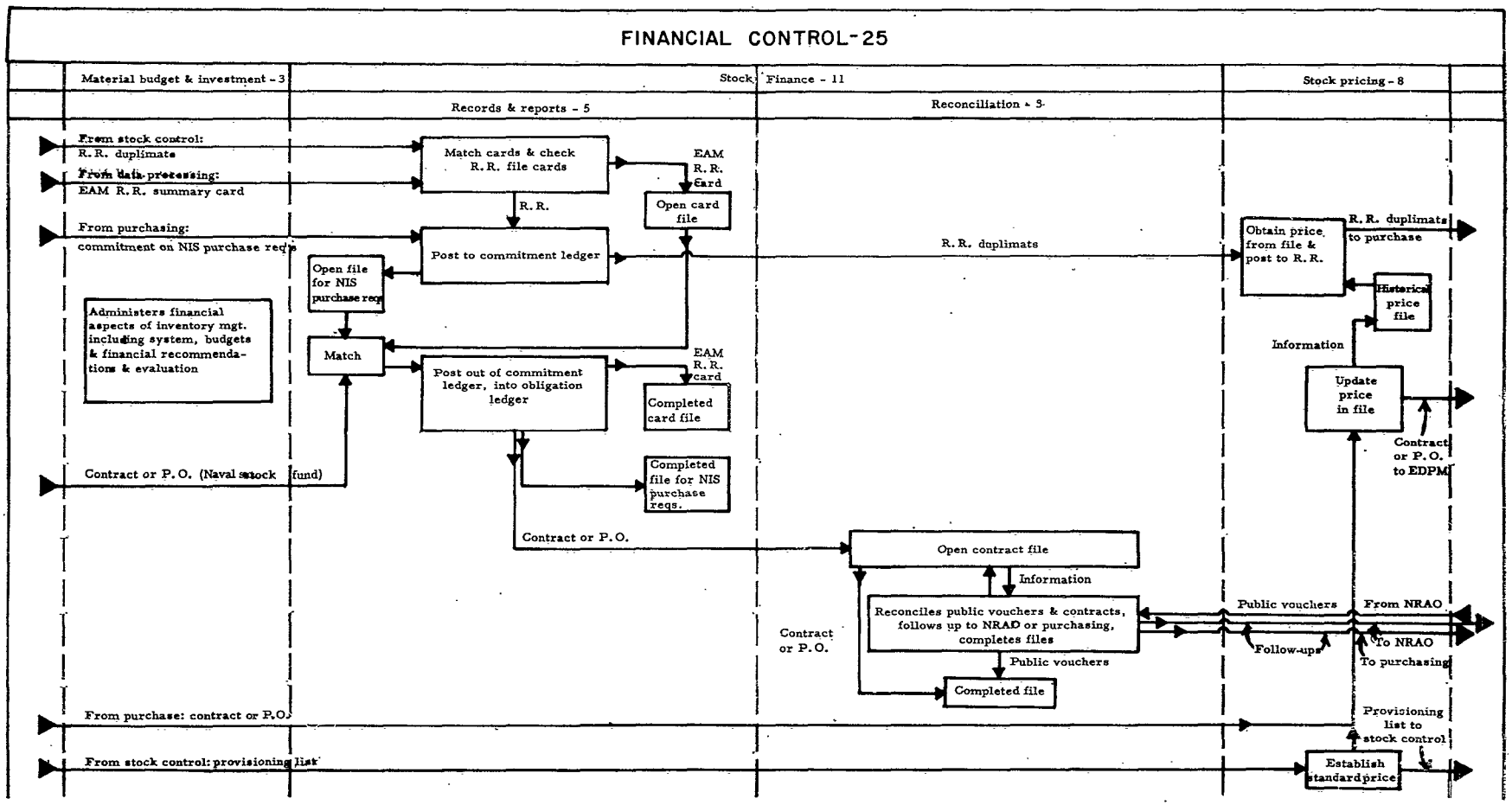
System Planning Division, Provisioning Coordination Branch
Data Processing Division
Financial Control Division
Technical Division
Stock Control Division
Purchase Division

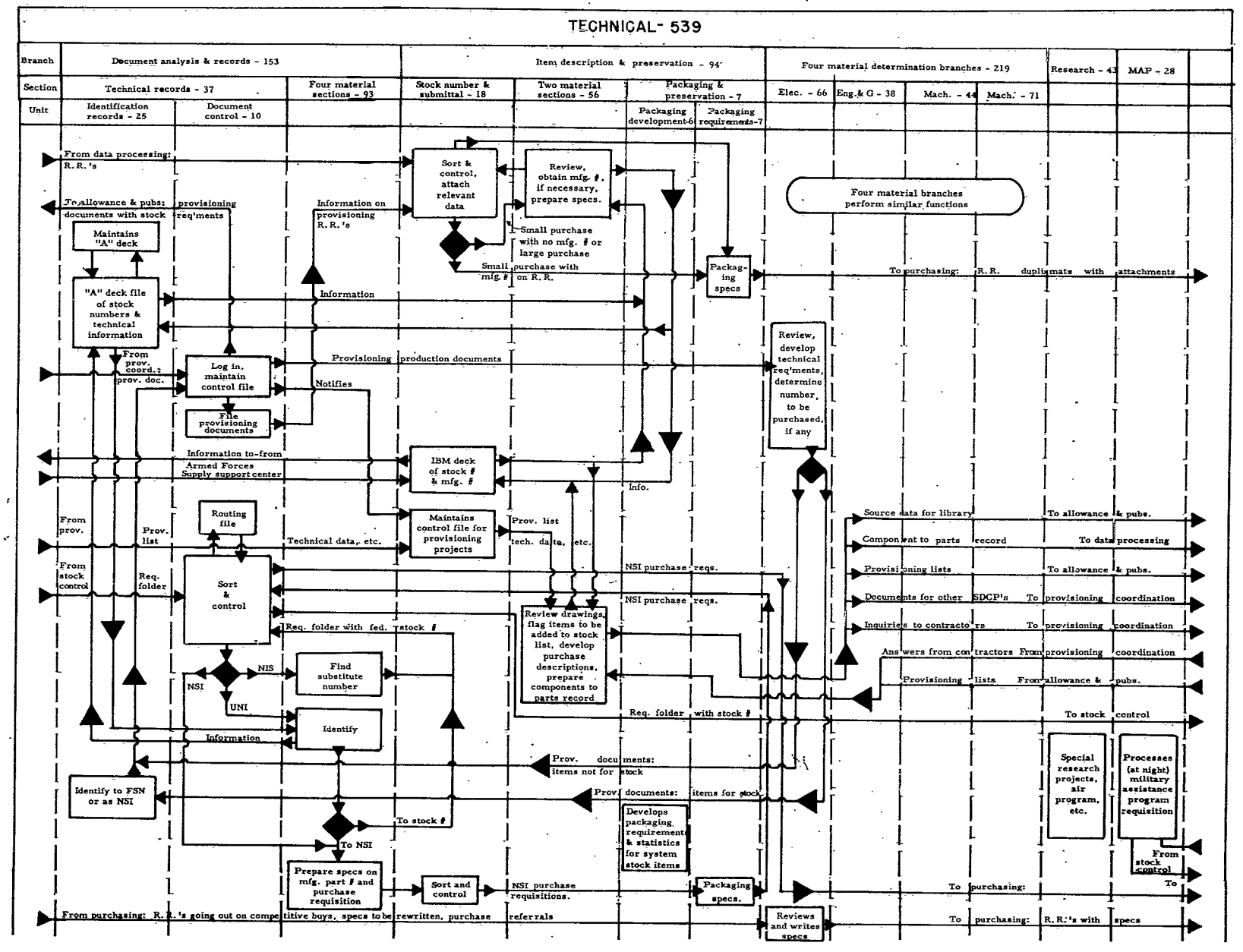

Branch - No. of personnel
System Planning,
PROVISIONING COORDINATION - 14
Section - No. of personnel
Coordination - 3
Control - 9
From purchasing activity (e.g., BuShips, shipyards):
contracts let
From manufacturer:
provisioning documents (e.g., production/provisioning lists and other data)
From other SDCP's requesting supply support:
provisioning documents
Logs in, assigns project number, sets up file
Contracts let by purchasing activities
Provisioning documents
Reviews, schedules conferences, schedules SPCC processing
Provisioning documents: containing all needed data
Processes
To technical: provisioning documents
Control card
Provisioning documents requiring more data
Writes or reviews and signs letters requesting more information
To manufacturer: letter requesting more data
To purchasing activity: copy of letter of inquiry
Prov. documents, copy of letter of inquiry
Letters of inquiry written by technical
Logs in
Provisioning documents
Temporary hold file
From technical:
provisioning documents with letters requesting more information
Project folder
From manufacturer:
information requested
Logs in, matches with material in hold file
Control card
Regular project files
To technical: provisioning documents
From technical:
provisioning documents with recommendations
Logs in, screens recommendations, determines distribution
Copies of all documents
To NSD, reproduction division: provisioning documents
For advanced buys
Reproduce provisioning documents
To stock control: prov. documents
From NSD, reproduction:
copies of provisioning documents
Distributes
To stock control: prov. documents
To technical: prov. documents
To allowance & publications: provisioning documents
Prepare documents for other SDCP's
Provisioning documents
For items requiring supply support from other SDCP's
Reviews, writes to other SDCP's requesting supply support
Provisioning documents & letters
Copies of letters and documents
Files copies of letters and documents, logs out
To other SDCP's: provisioning documents with requests for supply support
From stock control:
priced R.R.'s for provisioning items
From purchase:
contracts for provisioning items
File
Priced R.R.'s for provisioning items
Contracts for provisioning items

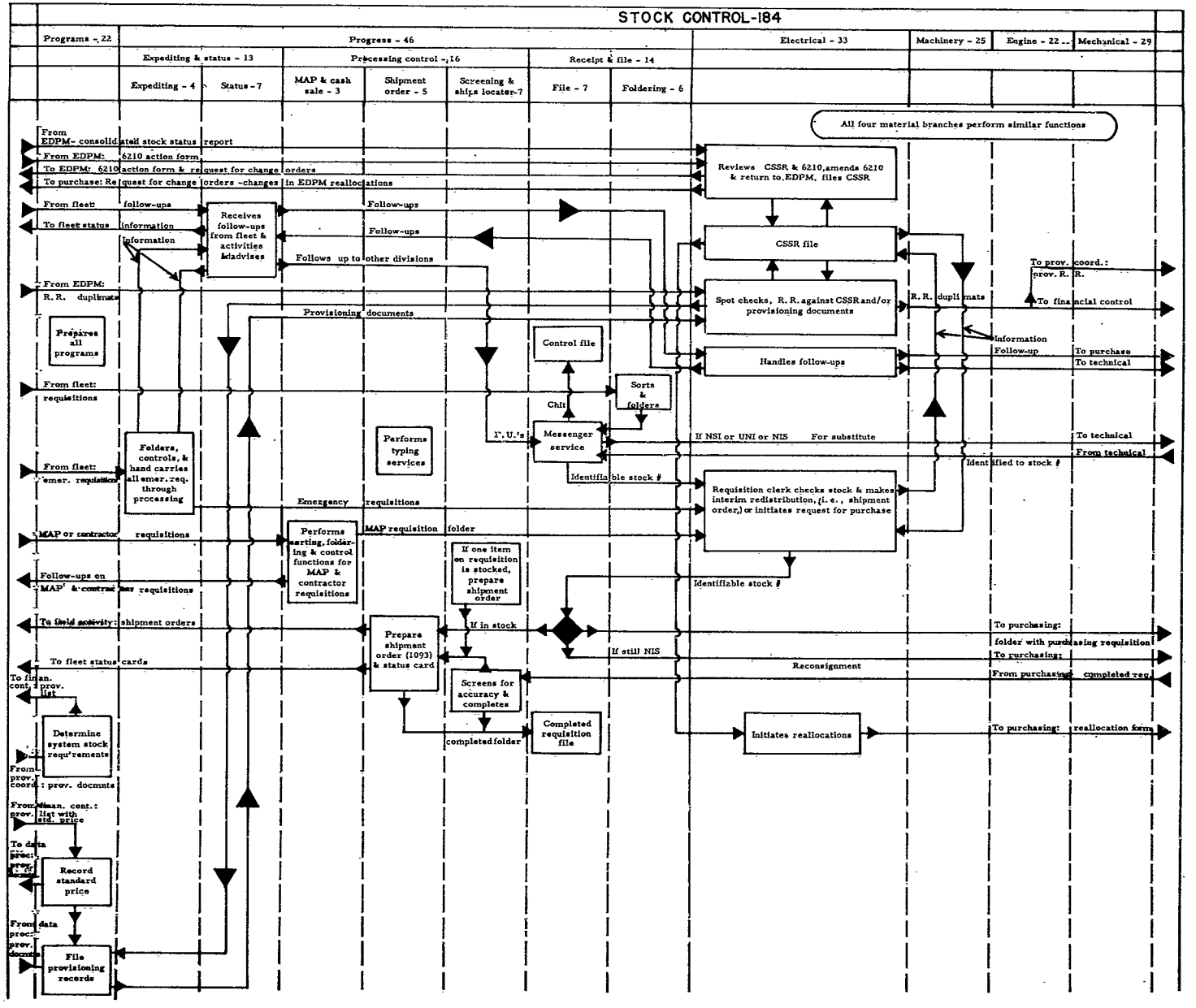
DATA PROCESSING - 205

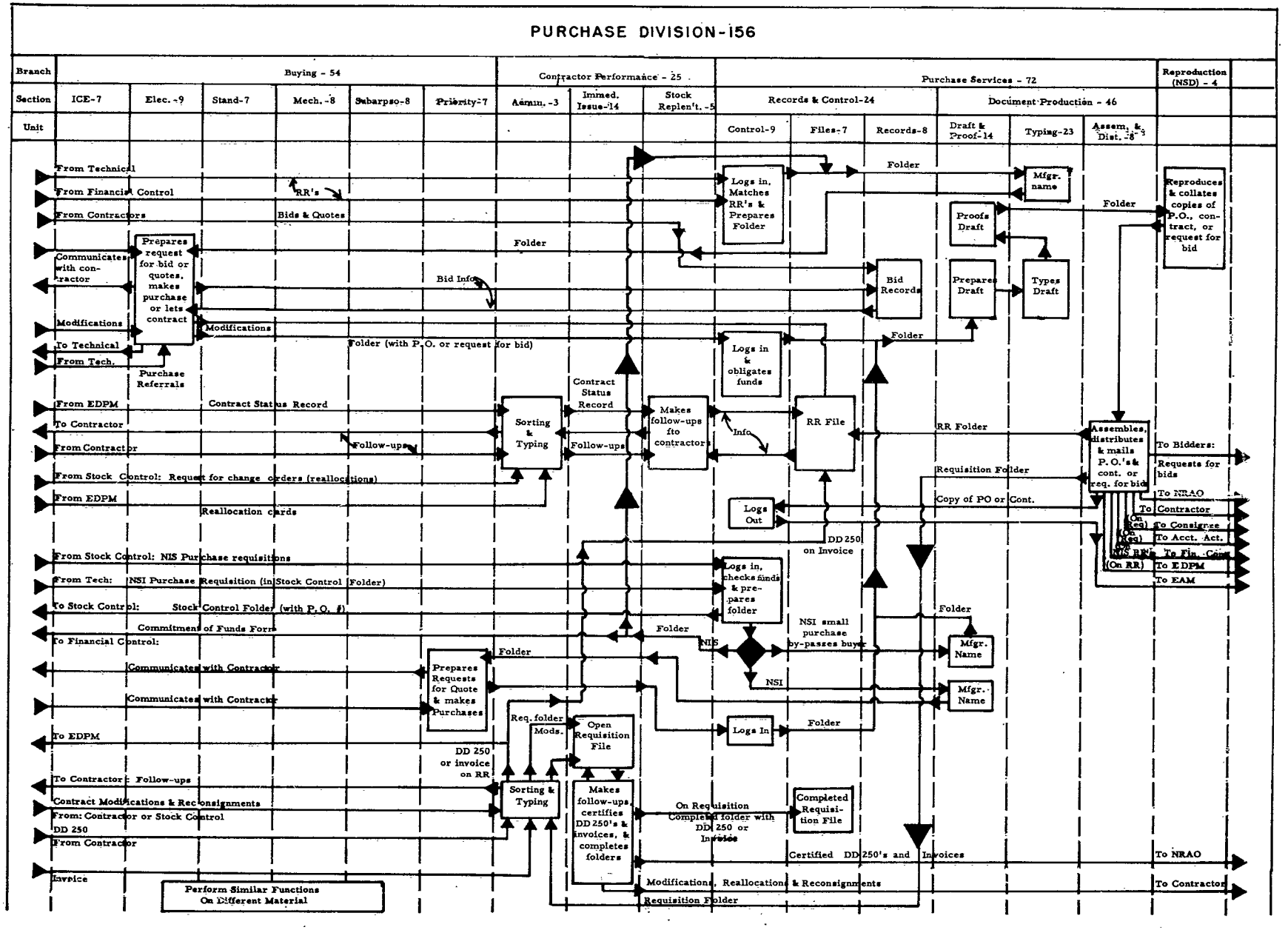


FINANCIAL CONTROL-25




TECHNICAL- 539
Branch
Section
Unit
Document analysis & records - 153
Technical records - 37
Identification records - 25
Document control - 10
Four material sections - 93
Item description & preservation - 94
Stock number & submittal - 18
Two material sections - 56
Packaging & preservation - 7
Packaging development-6
Packaging requirements-7
Four material determination branches - 219
Elec. - 66
Eng.& G - 38
Mach. - 44
Mach. - 71
Research - 43
MAP - 28
From data processing: R.R.'s
To allowance & pubs: documents with stock
provisioning req'ments
Information on provisioning R.R.'s
Sort & control, attach relevant data
Review, obtain mfg. #, if necessary, prepare specs.
Small purchase with no mfg. # or large purchase
Small purchase with mfg. # on R.R.
Packaging specs
Four material branches perform similar functions
To purchasing: R.R. duplicats with attachments
Maintains "A" deck
"A" deck file of stock numbers & technical information
Information
From prov. coord.: prov. doc.
Log in, maintain control file
Provisioning production documents
Notifies
File provisioning documents
Review, develop technical req'ments, determine number, to be purchased, if any
Information to-from Armed Forces Supply support center
IBM deck of stock # & mfg. #
Info.
From prov.
Prov. list
Routing file
Technical data, etc.
Maintains control file for provisioning projects
Prov. list
tech. data, etc.
Source data for library
To allowance & pubs.
Component to parts record
To data processing
Provisioning lists
To allowance & pubs.
Documents for other SDCP's
To provisioning coordination
Inquiries to contractors
To provisioning coordination
Answers from contractors
From provisioning coordination
Provisioning lists
From allowance & pubs.
From stock control
Req. folder
Sort & control
NSI purchase reqs.
NSI purchase reqs.
Review drawings, flag items to be added to stock list, develop purchase descriptions, prepare components to parts record
Req. folder with fed. stock #
Req. folder with stock #
To stock control
NIS
NSI
UNI
Find substitute number
Identify
Information
Special research projects, air program, etc.
Processes (at night) military assistance program requisition
Prov. documents: items not for stock
Prov. documents: items for stock
Identify to FSN or as NSI
To stock #
To NSI
Develops packaging requirements & statistics for system stock items
From stock control
To
Prepare specs on mfg. part # and purchase requisition
Sort and control
NSI purchase requisitions.
Packaging specs.
To purchasing:
From purchasing: R.R.'s going out on competitive buys, specs to be rewritten, purchase referrals
Reviews and writes specs
To purchasing: R.R.'s with specs


STOCK CONTROL-184
Programs - 22
Progress - 46
Expediting & status - 13
Expediting - 4
Status - 7
Processing control - 16
MAP & cash sale - 3
Shipment order - 5
Screening & ship's locater-7
Receipt & file - 14
File - 7
Foldering - 6
Electrical - 33
Machinery - 25
Engine - 22
Mechanical - 29
All four material branches perform similar functions
From EDPM- consolid. stock status report
From EDPM: 6210 action form
To EDPM: 6210 action form & request for change orders
To purchase: Request for change orders -changes in EDPM reallocations
Reviews CSSR & 6210, amends 6210 & return to EDPM, files CSSR
From fleet: follow-ups
To fleet status information
Receives follow-ups from fleet & activities & advises
Follow-ups
Follows up to other divisions
CSSR file
To prov. coord.: prov. R. R.
From EDPM: R. R. duplicats
Spot checks, R. R. against CSSR and/or provisioning documents
R. R. duplicats
To financial control
Provisioning documents
Prepares all programs
Control file
Information
Follow-up
To purchase
To technical
Handles follow-ups
From fleet: requisitions
Sorts & folders
Chit
I. U.'s
Messenger service
If NSI or UNI or NIS
For substitute
To technical
From technical
From fleet: emer. requisitions
Folders, controls, & hand carries all emer. req. through processing
Performs typing services
Identifiable stock #
Identified to stock #
Requisition clerk checks stock & makes interim redistribution, (i. e., shipment order,) or initiates request for purchase
Emergency requisitions
MAP or contractor requisitions
Performs sorting, foldering & control functions for MAP & contractor requisitions
MAP requisition folder
If one item on requisition is stocked, prepare shipment order
Identifiable stock #
Follow-ups on MAP & contractor requisitions
To field activity: shipment orders
Prepare shipment order (1093) & status card
If in stock
To purchasing: folder with purchasing requisition
If still NIS
To purchasing:
Reconsignment
From purchasing: completed req.
To fleet status cards
Screens for accuracy & completes
To finan. cont. & prov. dept.
completed folder
Completed requisition file
Determine system stock requirements
Initiates reallocations
To purchasing: reallocation form
From prov. coord.: prov. docmnts
From finan. cont.: list with stnd. price
To data proc.
Record standard price
From data proc.
File provisioning records


PURCHASE DIVISION-156
Branch
Section
Unit
Buying - 54
ICE-7
Elec. -9
Stand-7
Mech. -8
Subarpso-8
Priority-7
Contractor Performance - 25
Admin. -3
Immed. Issue-14
Stock Replen't. -5
Purchase Services - 72
Records & Control-24
Control-9
Files-7
Records-8
Document Production - 46
Draft & Proof-14
Typing-23
Assem. & Dist. -8
Reproduction (NSD) - 4
From Technical
From Financial Control
From Contractors
RR's
Bids & Quotes
Communicates with contractor
Prepares request for bid or quotes, makes purchase or lets contract
Modifications
To Technical
From Tech.
Purchase Referrals
Folder
Bid Info
Modifications
Folder (with P.O. or request for bid)
Logs in, Matches RR's & Prepares Folder
Folder
Mfgr. name
Proofs Draft
Folder
Reproduces & collates copies of P.O., contract, or request for bid
Bid Records
Prepares Draft
Types Draft
Folder
Logs in & obligates funds
From EDPM
Contract Status Record
To Contractor
From Contractor
Follow-ups
From Stock Control: Request for change orders (reallocations)
From EDPM
Reallocation cards
Sorting & Typing
Contract Status Record
Follow-ups
Makes follow-ups fto contractors
Info
RR File
RR Folder
Assembles, distributes & mails P.O.'s & cont. or req. for bids
To Bidders:
Requests for bids
To NRAO
To Contractor
(On Req) To Consignee
(On Req) To Acct. Act.
(On RR) To Fin. Cont.
(On RR) To EDPM
To EAM
Requisition Folder
Copy of PO or Cont.
Logs Out
DD 250 on Invoice
From Stock Control: NIS Purchase requisitions
From Tech: NSI Purchase Requisition (in Stock Control Folder)
To Stock Control: Stock Control Folder (with P.O. #)
Commitments of Funds Form
To Financial Control:
Logs in, checks funds & prepares folder
Folder
NIS
NSI small purchase by-passes buyer
Folder
Mfgr. Name
NSI
Mfgr. Name
Folder
Communicates with Contractor
Communicates with Contractor
Prepares Requests for Quote & makes Purchases
Folder
Req. folder
Mods.
Open Requisition File
Logs In
Folder
To EDPM
DD 250 or invoice on RR
To Contractor: Follow-ups
Contract Modifications & Reconsignments
From: Contractor or Stock Control
DD 250
From Contractor
Invoice
Sorting & Typing
Makes follow-ups, certifies DD 250's & invoices, & completes folders
On Requisition Completed folder with DD 250 or Invoice
Completed Requisition File
Certified DD 250's and Invoices
To NRAO
Modifications, Reallocations & Reconsignments
To Contractor
Requisition Folder
Perform Similar Functions On Different Material

APPENDIX II.

The following contractors were interviewed by members of the Research Team:

Arma Division, American Bosch Arma Corporation

Electric Boat Division, General Dynamics Corporation

The Leslie Company

Manning, Maxwell and Moore, Inc.

Worthington Corporation

The following contractors provided answers to written interrogration:

Velan Engineering Ltd.

Brook Labs Co., Inc.

Baldt Anchor, Chain and Forge Division of the Boston Metals Company

The Anchor Metal Spinning Co.